EDITORIAL

As the date for large-scale release of stereo records draws nearer, interest overseas is stepping up almost to fever heat in the record world.

The recent Audio Fair held in London saw desperate efforts by all interested manufacturers to show something allied to stereo.

In America, publicity is mounting in much the same way as it did when the LP record was first introduced. Articles are appearing in topical magazines, not primarily interested in such matters, explaining to all and sundry what stereo is and how it works. Most of these are authentic and quite extensive.

About September of this year I expect the silence of the big firms to be broken with their first overseas releases, and I equally expect them to be very good. Before the end of the year, such records, and some equipment to play them, should be available in Australia. After that I expect interest and development to proceed very rapidly.

I feel fairly certain of this for a reason I have mentioned in earlier issues. The impact of TV, despite all the hopeful thinking and best efforts in the world, is being felt throughout the entire entertainment field, which includes both records and radio.

It is significant that, co-incident with the rise of stereo records, comes announcement of practical schemes for stereo broadcasting.

Experiments with stereo methods for radio are now being conducted in various parts of the world. These include not only the use of separate channels for AM and FM, but a system of multiplexing on FM which allows two channels to be radiated from a single station.

This method has something in common with one already projected for records, but which has been suspended by its sponsors through a desire not to confuse the present stereo program, which is world wide, and because its difficulties might be too many to overcome its advantages.

Stereo increases the dimensions in listening which at the moment TV cannot match visually, and the industry expects it to revitalise the world of sound.

Its importance is even greater when we realise that, from now on, the vast majority of listening will be done by some form of reproduction as against live performance. The introduction of stereo will bring possibilities for exploitation which will affect every aspect of it.

John Moyle

RADIO ★★
TELEVISION
AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Looking into the heart of an experimental reactor during a reloading process shows the arrangement of fuel rods typical of the design. This one is attached to an American research institute.

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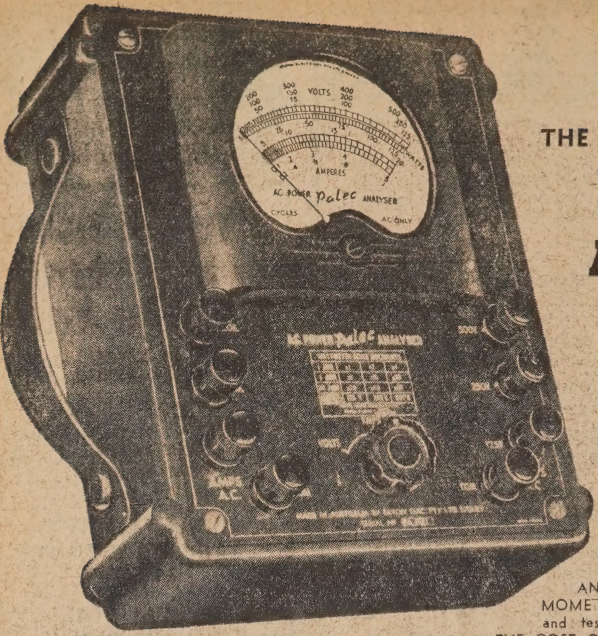

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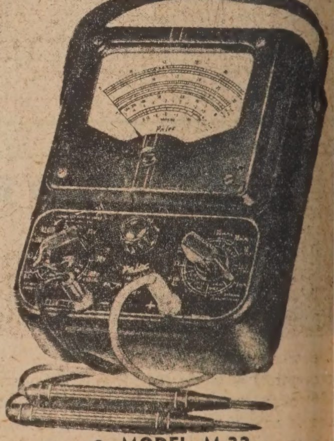

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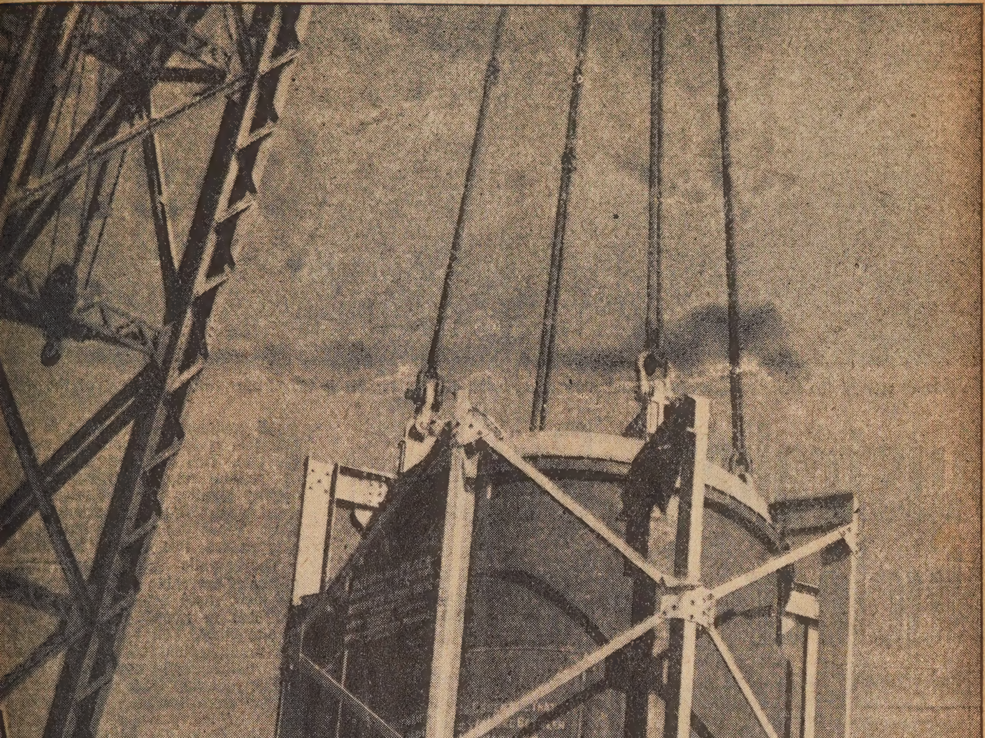
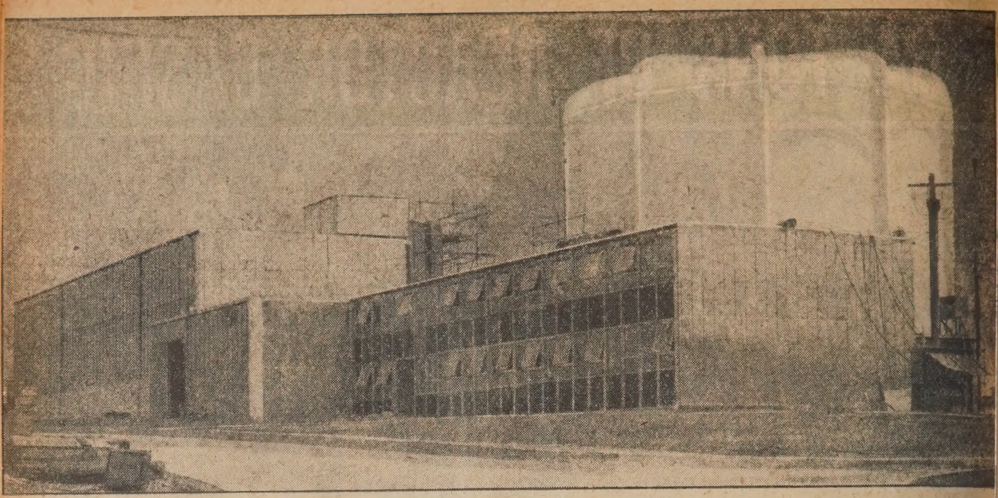
64 TONS OF REACTOR CASING



he steel tank in which the atomic reactor will operate is shown being unloaded from the freighter which rought it from Britain. It was supplied by Head Wrightson Processes Ltd. London and weighs 64 tons. It is 3ft high and has a diameter of 12ft 6in, with a four-inch thick lead lining inside. It holds the actual reactor, nd is now embedded in a heavy concrete shield and outer reactor casing. This heart of the reactor is actually e smallest section of all—mostly the building is taken up with controls, cooling circuits, etc. (See story on next page.)



A general view of the Lucas Heights reactor and surrounding buildings. The reactor is the circular, white structure at the right.

Australia's Own Nuclear Reactor

Nuclear energy has become so vitally important in the modern world that Australia cannot afford not to build up its own resources of knowledge and material facilities. Cheap, nuclear power is just as important to us as to anyone else. We will lag badly unless we can compete with other countries and adapt discoveries to our own uses.

ON April 18 the Prime Minister (Mr Menzies) opened the experimental atomic reactor at Lucas Heights, N.S.W., and virtually commenced the practical work of the Australian Atomic Energy Commission.

To date most of the activity has been occupied in clearing the site, erecting buildings, assembling test apparatus and staff, and of course building the HIFAR reactor for the benefit of which all this effort and expense has come about.

It will be many months yet before the reactor can do more than produce a token amount of energy, for such a potent instrument cannot be turned on and off like a water tap.

PROGRESSIVE TESTS

Scientists will carry out innumerable test runs under changing conditions, stepping up the power as their work progresses and the installations become more complete, until finally it is safe to use the full 10 megawatts capacity of HIFAR.

The reactor itself is not primarily a heat reactor of the type used to boil water and run turbines. It is intended to supply a source of radiation for the treatment of samples which are inserted into it. It does produce a great deal of heat in the process, but this is purely incidental. The heat is carried away and dispersed in a cooling system, although it could probably be used for some other purpose not directly connected with the reactor.

HIFAR means High Flux Atomic Reactor, a phrase which describes its character. It is in fact almost a duplicate of the DIDO which went into operation at Harwell two years ago, and many of HIFAR's research team have already had experience at the Research Establishment in England.

This is Australia's first reactor, but it certainly will not be its last. Rather than contemplate the necessity of buying industrial reactors in the future from overseas, Australia expects to embark on projects to design and build her own.

One of the jobs set down for HIFAR is the development of techniques for this purpose, for conditions here will pose special problems to those who will undertake the work in this vast and important field.

The fuel used in HIFAR is Uranium U238 enriched with some U235. It comes from overseas in flat slabs made up into rods each 2ft long and contained in aluminium sheaths for protection. The composition of these rods in detail is one of the few secrets about the reactor, which requires 25 of them when fully loaded.

To start up the chain reaction, a small container about as big as a four tain pen is lowered into the centre o the pile. This container has a mixtur of radium and beryllium, and it activity initiates the movement of neut rons which "fires" the uranium in th rods. When the reaction has been suit ably started, this nucleus is withdrawn

The atomic fire is controlled b means of moveable cadmium rods which by their rapid absorption of neutron are able to retard activity or to sto it altogether. The relative positions o the uranium and cadmium rods dete mine the degree of activity.

The radiation from the reactor is pr vented from escaping first by a su round of heavy water, then by 2ft o graphite, then 4in of lead and final 5ft of concrete. The heavy water, o which 22,000lbs were imported fro America at a cost of £277,200 ac firstly as a moderator which slows th movement of neutrons to a mo manageable speed, and as a coola which conducts heat away from th uranium into a heat exchanger. The e changer removes the heat from the hea water and transfers it to a moving flo of cold water which carries it aw from the reactor.

LARGE WATER SUPPLY

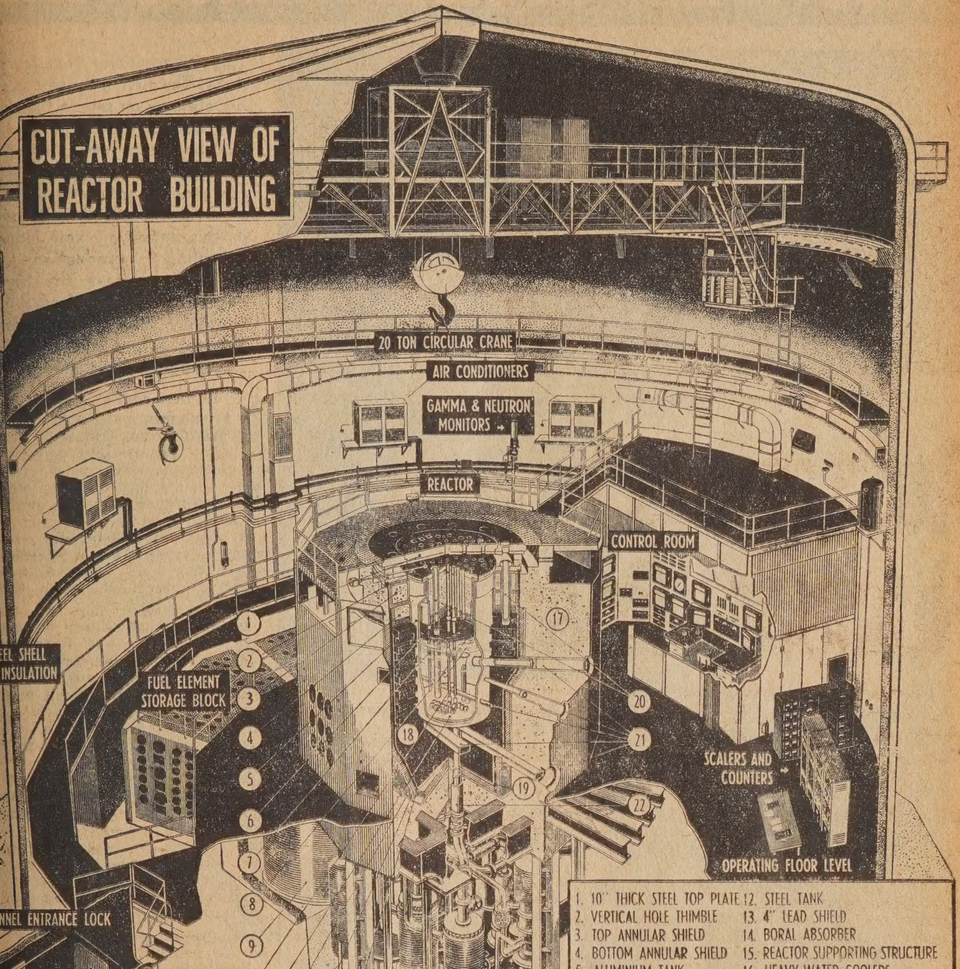
Something like 80,000 gallons water per day will be needed to co the reactor—ordinary tap water fro the mains.

The heavy water is kept within closed circuit in the reactor, returni to the "hot spot" again and again as circulates through a pattern of pipes b neath the main chamber.

The High Flux part of HIFAR's na indicates that the concentration neutron movement in its heart is ve high, something like 10,000 billion p square centimetre per second .Burni uranium can attain a temperature several millions of degrees—one pou of it could boil three million gallons water. Such temperatures are not p mitted within HIFAR.

The high flux concentration will all very potent isotopes to be produ when the reactor is operating at f power.

CROSS SECTION DIAGRAM OF NUCLEAR REACTOR


CUT-AWAY VIEW OF REACTOR BUILDING
20 TON CIRCULAR CRANE
AIR CONDITIONERS
GAMMA & NEUTRON MONITORS
REACTOR
CONTROL ROOM
EL SHELL INSULATION
FUEL ELEMENT STORAGE BLOCK
SCALERS AND COUNTERS
OPERATING FLOOR LEVEL
NNEL ENTRANCE LOCK
PIT
1. 10" THICK STEEL TOP PLATE
2. VERTICAL HOLE THIMBLE
3. TOP ANNULAR SHIELD
4. BOTTOM ANNULAR SHIELD
5. ALUMINIUM TANK
6. HEAVY-WATER LEVEL
7. FINE CONTROL ROD
8. COARSE CONTROL ARM
9. HEAVY-WATER TANK
10. FUEL ELEMENT
11. HEADER PLATE
12. STEEL TANK
13. 4" LEAD SHIELD
14. BORAL ABSORBER
15. REACTOR SUPPORTING STRUCTURE
16. HEAVY-WATER COOLERS
17. CONCRETE SHIELD
18. GRAPHITE REFLECTOR
19. LEAD THERMAL BOND
20. VERTICAL FACILITIES
21. HORIZONTAL FACILITIES
22. 9" HEAVY-WATER INLET
RLES ALTMANN

This cross-section of the reactor illustrates its construction in detail.

reactor housing itself is a steel re 1in thick, 70ft high and 70ft It is coupled to an adjacent g and is entered by an air-lock h which operating staff must pass controlled conditions when it is ng.

le this shell stands the reactor 30ft high, 20ft across, with 10 les.

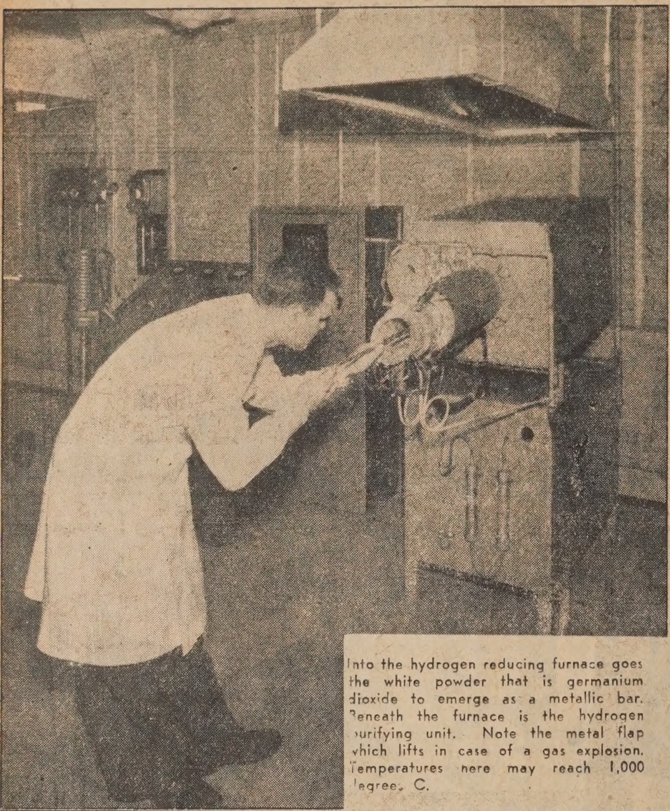
ve it is the moveable crane and ell-like hole through which the re inserted. Beneath it is housed ancillary equipment such as the heat exchanger.

On a wide landing which surrounds the reactor are banks of meters and racks of instruments to check and control its operation. In a glass-covered room is the control console at which a summarised picture of the reactor's condition can be seen at any moment. This is the nerve centre of the entire operation. Emphasis is on temperature, for a change one way or another can indicate danger or failure.

In this room is the famous "Scram" button which, when pressed, shuts down the reactor, alerts all personnel, and sets an extensive emergency drill into operation.

Attached to the reactor is a collection of laboratories and training facilities at which engineers and scientists from all over Australia can make use of its facilities. The total cost of more than £6-million is high, but the value received on a national basis cannot be measured in money.

AUSTRALIA MAKES TRANSISTORS



Into the hydrogen reducing furnace goes the white powder that is germanium dioxide to emerge as a metallic bar. Beneath the furnace is the hydrogen purifying unit. Note the metal flap which lifts in case of a gas explosion. Temperatures here may reach 1,000 degree. C.

This is a transistor year for Aus
tralia. The first transistor receiv
ers are now on sale in the shops
and before 1959 appears ther
will be many more. Transisto
production in this country ha
now begun, and soon there wi
be a number of firms engage
in this important new industry
Mounting production wi
eventually remove the bigges
drawback of the present time—
relatively high price. There i
a great future ahead for thi
mighty little midget.

AT its Alexandria factory, Stan
Telephones and Cables Pty. Lt
now making transistors, and is the
Australian company to do so. T
manufactured at present are for us
audio circuits, but later on others
be added, including a range intende
use in R.F. circuits.

At the present time, R.F. types
imported from overseas, but it sh
not be very long before Australian
ceivers can be fitted entirely with
tralian-made transistors.

The photographs shown in these
were taken at the STC factory, an
have used them to illustrate various
in the manufacturing process.

Fundamentally this is not particu
complicated, but it does include a
ber of operations which require
accurate production control, and a
degree of factory cleanliness.

Most of the world's supply of
manium, the metal which forms the
of the transistor, comes from the Be
Congo, its exact source being a
heap of waste slurry built up at a
used for zinc refining. Because it
considered to be rich in various mi
deposits, the heap had been pres
for further examination.

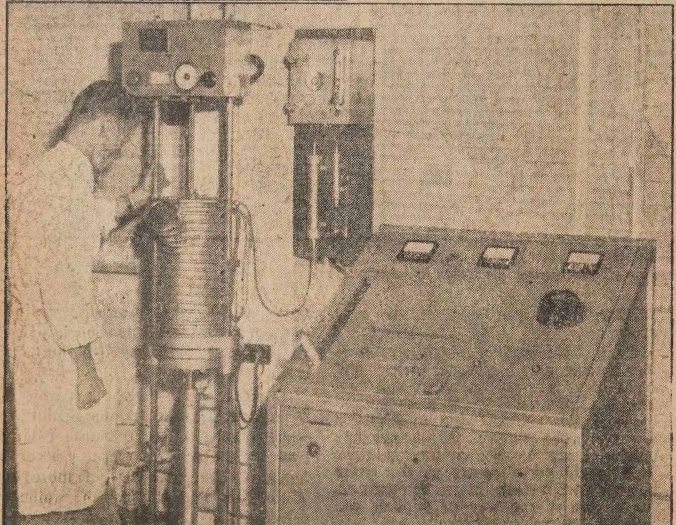
A WHITE POWDER

Eventually it was found to be ri
germanium dioxide, which is extract
the form of a white powder.

Although a metal, germanium
bines easily with other elements, a
rarely if ever found in its natural
Canada has a limited supply,
strangely enough it is found in c
kinds of chimney soot, which
proved the source of a small qu
extracted in Great Britain.

Germanium dioxide used for tr
tors must be refined to a very hig
gree, and for this purpose, the Be
ship their treasure trove to Europ
processing, and thence to factori
other countries which draw upor
supply.

It is probable that other sourc



This is the crystal-growing unit thro
which the operator watches the
version of the metal bar. Accurate
perature control is essential here.
seed crystal is slowly withdrawn
the mechanism above the unit.

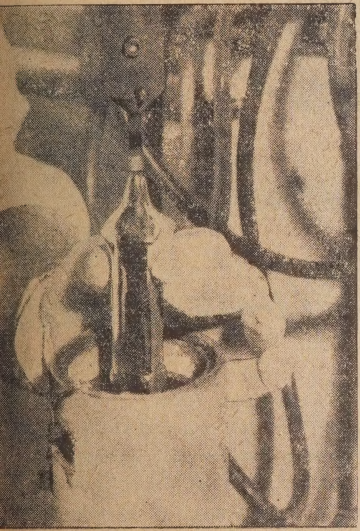
nium will eventually be discovered. present in coal, for instance, and portance of transistors is so great very effort will be made to search

first step in the manufacturing s is to convert the dioxide into ermanium. The powder is thereassed through an electric furnace heats it to a very high temperain the vicinity of 1,000 degrees rade.

sically it is contained in a long w "boat" made of chemically pure te which acts as both a container mould to shape it into billets or bout 12 inches long and 1 inch section. The graphite must be to avoid contaminating the german.

furnace operates in an atmosphere drogen which combines with the n of the germanium dioxide leave pure metal behind. Commercial gen is not "clean" enough for the se, so the gas passes through a r on its way into the furnace.

e it exists as an atmosphere at low re to prevent any air from enter form an explosive mixture.



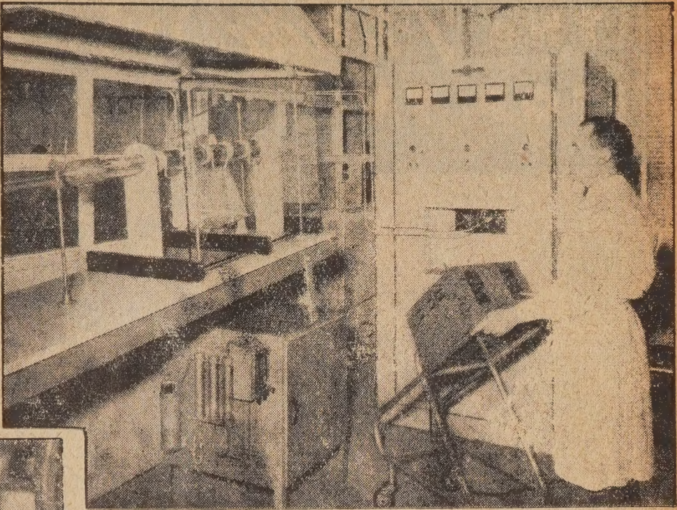
open end of the furnace is closed metal flap, so that, if an explosion d occur, the blast will be free to without causing any serious dam-

the end of the hydrogen reduction ss, we are left with a bar of geram metal.

next step is to pass the bar gh a final cleansing process known one refining" to remove any trace ntamination. This is so effective at the end of it, the amount of n matter remaining is estimated more than .0000001 per cent.

s almost unbelievable standard is d by passing the germanium, still graphite boat, through a tube of which is surrounded by an R.F. g coil arranged in six sections. The fed from a huge R.F. oscillator an output power of 20 kilowatts generated by two water cooled valves.

METAL MUST BE COMPLETELY PURE

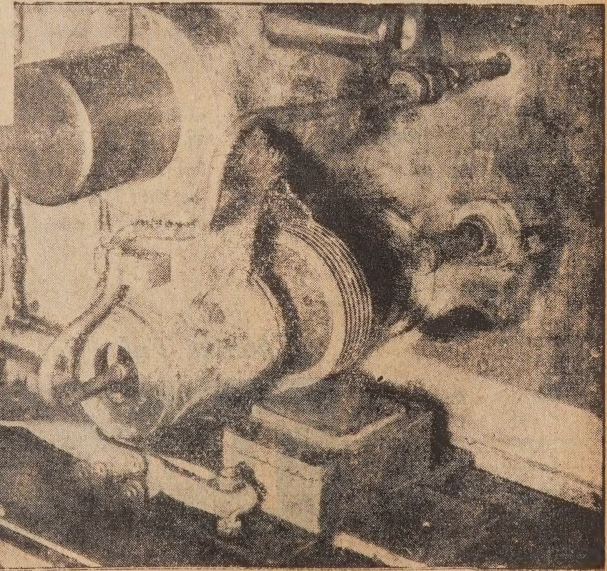


Here the germanium bar is travelling through the quartz tube with its six heater coils to purify the germanium. Nitrogen cleaning unit is below the bench, the RF heating unit at the right. The boat is drawn through the tube by the quartz rod emerging through a gas-tight joint at the end.

The boat is pulled through the tube from one end to the other by a quartz bar attached to a length of steel wire and operated by an electric motor.

Each time a section of the bar passes through one of the heating coils, it becomes molten by the heating action of the R.F. power. As this molten section is pulled out of the coil, it solidifies, only to be melted again as it comes within the field of the next coil.

A close-up of the germanium crystal being drawn from the furnace by the rod to which the "seed" crystal is attached. This is the interior of the crystal-growing unit shown on opposite page.



e-up of the ganged wheel which the crystal slabs into small dices. thin slab is attached to a ceramic tile to support it for cutting.

The *'Picture'* Tube for TOP TV

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- ★ **Short or Standard Length Necks.**

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manufactured by

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Thomas PICTURE Tubes

s the whole bar melts and solidi- x times as it is slowly pulled h the complete coil, a process takes five hours. In effect, a ion of six molten waves moves he bar from the front to the rear rawls along the quartz tube.

reason for this molten wave in the germanium is that any ties in the bar remain in the sections, and do not resolidify ie metal. As a result, they move the bar to the far end during the les. When the bar has completed rney, these impurities are collected nall portion of the bar at the end last emerges from the heating

OGEN ATMOSPHERE

all metals behave in this way, rmanium is one of them, and it is nvenient characteristic which al- such an effective and ingenious l to be used.

quartz tube is filled with nitrogen low pressure, again to provide nosphere, but this time an inert ainly to prevent oxygen and other n the air from recombining with rmanium and defeating the pur- f the whole process. The nitrogen elps to cool those sections of the nich are solidifying between their periods.

end of the bar in which the im- s are concentrated must now be ay, and the problem is to deter- how much should be removed. s done by making a conductivity the bar with four probes which e the specific resistance of its section.

n the impure portion is reached e probes, the specific resistance s, and at this point the bar is cut.

discarded ends are later re- sed to avoid waste of a very ex- e metal.

sed in a transistor, the germanium e in crystalline form, and so the ep is to grow a large crystal from tal.

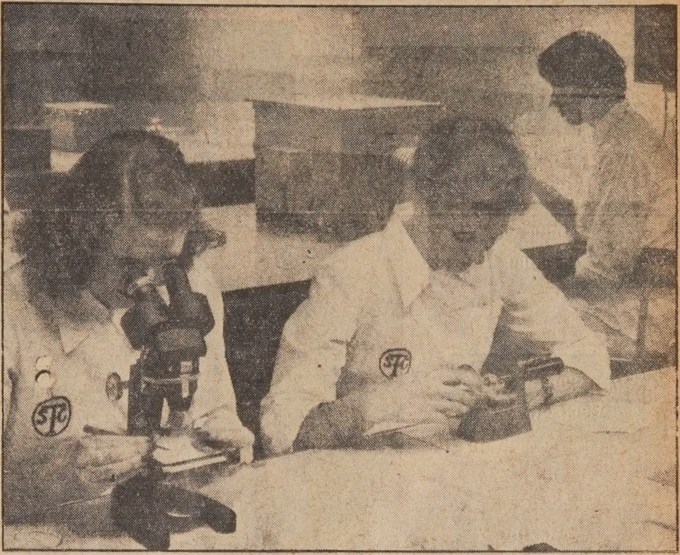
this purpose the bar is placed in other electric furnace and heated t is just molten. This requires a ontrol which is accurate to within 0.2 degree, an extremely difficult a temperature of 1,000 degrees melting point of germanium.

ERATURE CONTROL

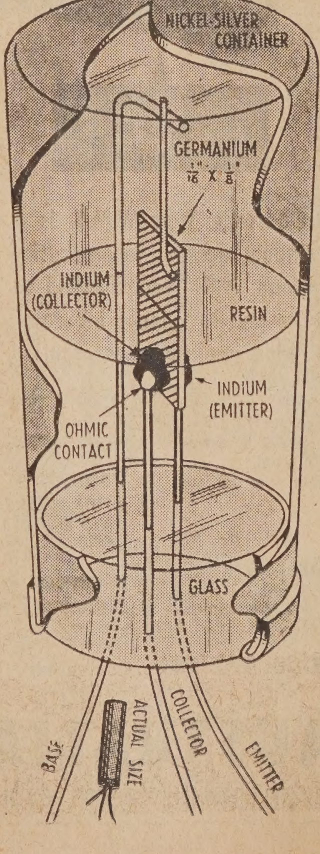
control circuit includes a thermo- which feeds a DC amplifier con- a servo mechanism to adjust the flow to the furnace—a type of ck circuit which automatically es the temperature.

le in this furnace, a small, ac- y controlled amount of some suit- ement, such as antimony, is added molten germanium, its exact and quantity depending on the f transistor and the special tech- developed by the manufacturer. of them don't issue too much in- ion on their methods as used here, for they involve very deeply the quality of the finished product.

FINAL CHECKING AND ASSEMBLY



Transistors are so small that microscopes and precision gauges are freely used. At left, an operative checks a completed assembly; at right, another measures the thickness of a germanium wafer. Behind her is the furnace in which the indium pellets are fused to the germanium crystals.



drawing shows the assembly of a istor. Indium pellets are fused to crystal slab on each side, con- ng leads emerge from the glass There are many variations in the l arrangement of leads and sup- and of dimensions. Note actual size of typical transistor.

To start the crystal growing, a small seed of crystalline germanium fastened to the end of a rod is allowed to lightly touch the surface of the metal. It is then slowly rotated and withdrawn, bringing with it the top end of the gradually crystallising metal in solid form. When the bar is entirely lifted from the furnace, it is a complete germanium crystal.

It is interesting to note that practically all the "seeds" used to initiate this process came from the original crystal made by the Bell Telephone Laboratories in the early days of germanium production. It is important that this crystal should be perfect in its form, otherwise the large crystal grown from it will repeat its imperfections and be ruined.

The time taken for this step is about 4½ hours, at the end of which we have a bar about 9in long and a triangular cross-section measuring about 1in.

CUTTING THE CRYSTAL

The germanium crystal is now cut into tiny rectangular pellets. It is first sawn into slices about 20 thousandths of an inch thick, and lapped on both sides to ensure flat surfaces, a process which reduces them to half their original thickness.

Each slice is then attached with wax to a ceramic tile and diced by ganged diamond-tipped cutting wheels into rectangles, measuring 1-8in x 5-32in.

The final step is to attach the tiny

E·M·I MEASURING OSCILLOSCOPE TYPE W.M.S

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Industrial Research

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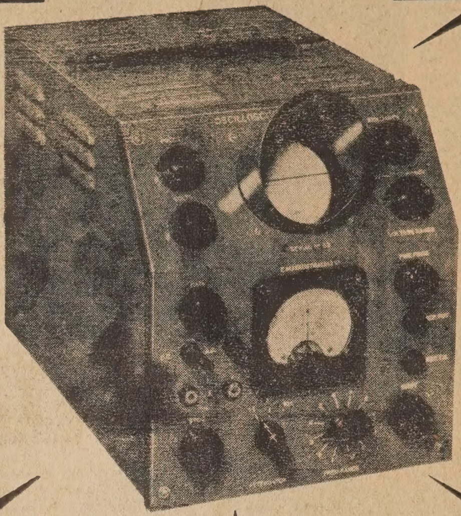

Production Testing

"Services" Workshop Testing

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Symmetrical Deflection

Visual Null Bridge Measurement

5 Range Voltmeter

Wide Range Time Base

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★ **ATTENUATOR.** X1-X2-X10. Fine Gain Control 10:1.

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★ **FULL 1.3 mc/s BANDWIDTH** maintained at all gain settings (3 db down).

★ **VOLTAGE MEASUREMENT RANGES:**

5 — 0 — 5   50 — 0 — 50   500 — 0 — 500
10 — 0 — 10   100 — 0 — 100
2" scale centre zero meter.

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7.5 c/s to 90 kc/s in 12 ranges (3:1 fine freq. control).

★ **EXTERNAL TIME BASE** requires 56 volts P-P for F.S.D. (20V r.m.s.).

★ **POWER SUPPLY.** 110, 200, 210, 220, 230, 240, 250 volts; 50 C.P.S.; 90 watts A.C.

★ **WEIGHT:** 24 lbs.

★ **INPUTS**	**ATTENUATOR**	**INPUT R**	**INPUT C**
A.C. or	X1	1 meg.	65 pF approx.
D.C.	X2	2 „	65 „ „
	X10	10 „	35 „ „

★ **DIMENSIONS:** Height, 9½"; Width, 8½"; Length, 13".

★ **CATHODE RAY TUBE:** 2½" diameter, type 3AFP4.

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TR.32.F

of indium to each side of the crys- gether with the connecting leads.
m now on, operations must be car- out under conditions of extreme iness. This part of the factory is ughly air-conditioned, and dust re- l from the air by precipitron units, germanium is very easily contam- . Sticky rubber mats cover the to catch any dust particles which n, the operatives using special lint- clothing. The factory is vacuum- ed twice each day, the collected examined by one of the engineers hemically analysed as well. All have air locks as a protection st the outside air.

assembly jig is loaded first with ystals, now chemically etched and ed in thickness thereby to 5 thou- ns of an inch. Next follow the in- pellets of about the same dimen- which have been punched to size. led, too, is a nickel connecting tab he germanium, ready tinned with for the purpose.

OY FURNACE

the last time the embryo tran- passes through another hydrogen ce and is heated to the melting of indium, which is thus fused to urfaces of the germanium. The of penetration is governed by the rature which thus gives some meas- f control over this operation.

that now remains is to mount the stor on the stem assembly, a glass contained in a metal shell. Through erges the nickel tab attached to the l, and the two nickel wires, 5- andth of an inch in diameter, which oldered to the indium pellets with l low melting point solder (130C).

this stage the transistors undergo a ninary test, and are then enclosed can filled with epoxy resin, which nly ensures good thermal conduc- but locks the whole assembly in

e base of the can is soldered by ntrated RH heating at the flange, oo much heat applied to the com- assembly at this stage would pos- damage the transistor.

24 Kw heater is employed which the job during a pulse of 1 second ion.

AL RECOVERY

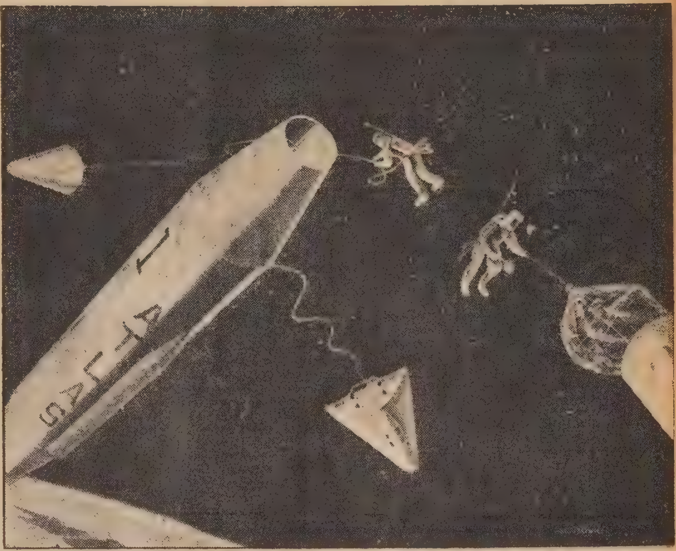
will be obvious that, during this ssion of events, a good deal of the al germanium metal bar has been up by so much cutting, grinding tching.

t the waste metal is all carefully red up, recovered, and reprocessed, at much of it goes "through the many times before finding its way the finished product. It is estimated only 10 per cent of the bar remains the first processing, and as german- is so costly, this recoverage is a y important matter in the factory makes these tiny but vastly import- idgets.

to the crystallising step, all ger- m processing is the same, but from oint there are many variations to ifferent types of transistors. Those bed are diffused alloy P-N-P types ed for audio work. Transistors for ork are made differently—for one the germanium crystals are very thinner.

this issue will be found the second part of an article which outlines the theory behind the operation of transistors, the first part of which was published in last month's issue. Our picture story will be complete if you refer to this article, for it will tell you just why they are made this way, and how they are able to give results which are rapidly changing the pattern of so much electronic equipment.

WILL OUTER SPACE BE LIKE THIS



With dreams of space travel coming nearer to reality, engineers and scientists are continuing their plans for the great day. This is an artist's conception of the intermediate stage in establishing an "Atlas" space station 400 miles above the earth. Its sponsors say that the station would provide an early capability for proving long-term existence in space. The basic structure of the station, the propellant tanks of the Atlas, is in orbit at the left. Its cap is removed for access. Crewmen have arrived in a glider, bottom centre, launched into the space station orbit as part of the upper stage of a modified Atlas. The rubber nylon inflatable capsule which will form the living quarters aboard the space station is being removed from the cargo ship, right.

Krafft Ehriche, Convair space expert, explains the crew quarter details of a model four-man space station to a U.S. Air Force officer. The station would provide a four-level crew quarters including a washroom at left, eating-recreation room, sleeping facilities and control room.

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BBC HAS TAPE RECORDER FOR TV

W TECHNIQUE VES HIGH RFORMANCE

B.B.C. has developed a com- ly new equipment for record- V programs on tape. This art- prepared from a talk by Dr Axon of the B.B.C., and from al reports, describes how it s. It is quite different from osed American systems and s a big step forward in technique.

L recently the recording of tele- sion pictures has been carried out by using a motion-picture cam- d photographic film. This, when ed, reveals a series of separate s along its length. When the film for a subsequent broadcast, the s upon it must be turned into the equired by the television system. icture along the film is, therefore, d in a machine such as a flying- anner which puts the information nto the correct form.

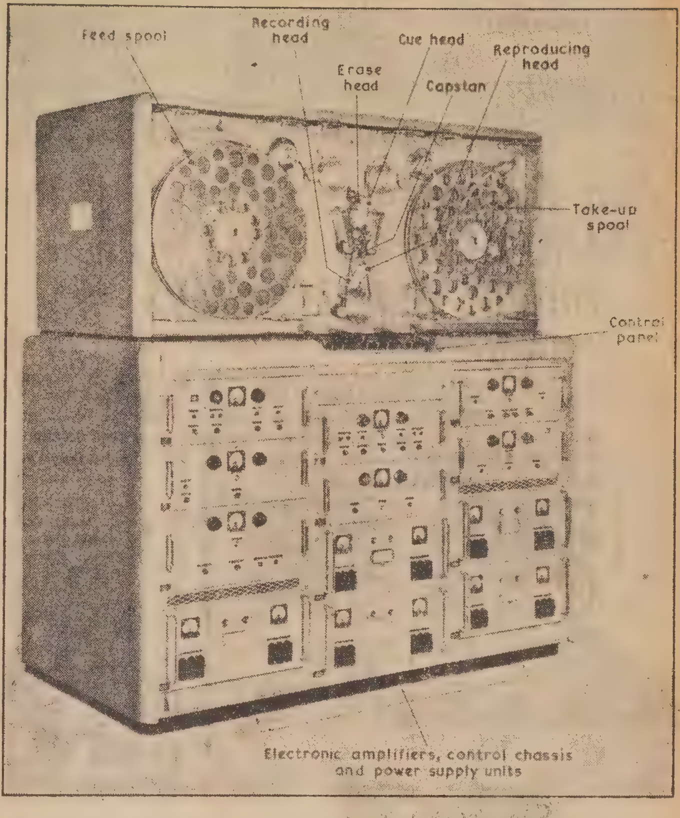
ve picture on a television screen t up of a series of electronic s which, in live sequences, come he television camera. Each picture e up of a series of horizontal hich are traced across the screen electron beam inside the tele- tube. The intensity of the beam, nce the light from the screen, e to correspond at each point e light intensity in the original

H. SIGNALS

the electron beam has to be ed when to commence each pic- d each line within it. This is d by sending out from the camera ar series of synchronising pulses. levision signal therefore consists hronising pulses and picture in- on lying between them.

he new magnetic recording of on pictures no photographic pro- involved, and the signals recorded ose from the television camera that is the synchronising pulses interleaved picture information. formation is established imme- and no processing of the tape red. The recording can be repro- immediately the tape has been d.

it is no longer required, the ay be wiped and used again to new programmes. Clearly, the can provide economy and imme- wo important features in a tele- ervice. Although this is all very in principle the engineering nents required to provde a satisfactory picture are very complicated and in recent years a great deal of research has been devoted to solving the technical problems.



The first lies in the frequency spectrum required to carry the picture information. High-quality sound recording involves the recording of frequencies up to about 15 thousand cycles per second. Television picture recording involves the recording of frequencies up to about 4.5 million cycles per second and even higher.

TAPE PROBLEMS

A second group of problems arises in connection with the tape itself. This consists of a plastic backing which is coated with a finely-powdered oxide of iron. In the recording and reproduction of high frequencies it is essential that the effective separation between tape and head surfaces is small and that this separation is not subject to sudden increases, as would arise from agglomerations of particles or dust in the coating. Great care must, therefore, be taken in the manufacture of tapes.

The third group of problems is concerned with the transport of the tape past the recording or reproducing heads. Here again the difficulties are much greater than in normal sound recording for the speed constancy required for satisfactory television recording is very much higher. If a steady picture is to appear on the television screen the synchronising pulses and the information between them must follow at a steady rate.

HOW IT WORKS

The B.B.C. Vision Electronic Recording Apparatus is shown herewith. The channels which are to be put into service will consist of two such machines which can be controlled from a central control desk. The machine employs half-inch magnetic tape and a reel (20¼in diameter) such as those shown will accommodate 15 minutes of programme.

Continuous recording is possible by the use of two machines and the control desk. The tape speed employed in the present model is 200in/sec and the magnetic tape used may be a normal thin-base sound-recording tape of good quality.

The machine employs a three-track system of recording, two of the tracks being devoted to the storing of the video signal and one to the storing of the

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TYPE 931-15: 20 watts.
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Resp.: 10-60,000 cps.
Valves: EL37, KT66 6L6 etc.
19% Screen Taps.

TYPE 931-8: 20 watts.
Prim.: as 931-15.
Sec.: 2 or 8 ohms.
Resp.: As 931-15
Valves: As 931-15.
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TYPE 921-15: 20 watts.
Prim.: 6600 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-60.000 cps.
Valves: 807, KT66, etc.
19% Screen Taps.

TYPE 921-8: 20 watts.
Prim.: As for 921-15.
Sec.: 2 or 8 ohms.
Resp.: As 921-15.
Valves: As for 921-15.
19% Screen Taps.

TYPE 916-15: 12 watts.
Prim.: 8500 ohms P.P.
Sec.: 3.7 or 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6BW6, 6V6, KT61, etc.
19% Screen Taps.

TYPE 916-8: 12 watts.
Prim.: As 916-15.
Sec.: 2 or 8 ohms.
Resp.: As for 916-15.
Valves: As for 916-15.
19% Screen Taps.

TYPE 949: 12 watts.
Prim.: 8000 ohms P.P.
Sec.: 2, 8, 12.5 and 15 ohms.
Resp.: 10-50,000 cps.
Valves: 6V6, 6BW6, KT61, EL84, etc.
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HIGH FIDELITY

FOR MULLARD "5-10" AMPLIFIER

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OUTPUT TYPE

TYPE 870 — 6 watts.
Prim.: 10,000 ohms P.P
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(for "Rola" 120X)

TYPE 871 — 12 watts.
Prime.: 10,000 ohms P.P
Sec.: 2 or 8 ohms.

TYPE 872 — 12 watts.
Prim.: 10,000 ohms P.P
Sec.: 3.7 or 15 ohms.

HIGH FIDELITY + - 1db 30-15,000 cps

OUTPUT TYPE

TYPE 763 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

TYPE 920 — 15 watts.
Prim.: 5000, 3000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 897 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 500, 250, 166, 125 and 100 ohms.

TYPE 896 — 15 watts.
Prim.: 10,000, 8000 ohms P.P.
Sec.: 15, 12.5, 8, 3.7 and 2 ohms.

MEDIUM FIDELITY + - 2db 50-12,000 cps

Type	Watts	Primary	Secondary
809	15	500 ohms	15, 12, 8, 3.7, 2, ohms
914	15	5000, 3000 P.P.	500, 250, 166, 125 and 106
915	15	5000, 3000 P.P.	15, 12.5, 8, 3.7 and 2
917	15	10,000, 8000 P.P.	500, 250, 166, 125 and 100
918	15	10,000, 8000 P.P.	15, 12.5, 8, 3.7 and 2
922	25	8000 P.P.	500, 250, 166, 125 and 100
891	35	6600 P.P.	500, 250, 166, 125 100, 83 ohms
892	55	3200 P.P.	500, 250, 166, 125, 62 and 50
928	5	7000, 5000 S.E.	12.5, 8, 3.7 and 2
929	10	4000, 2500 S.E.	15, 12.5, 8, 3.7 and
930	10	4000, 2500 S.E.	500, 250, 125
932	7	10,000 P.P.	15, 12.5, 8, 3.7 and

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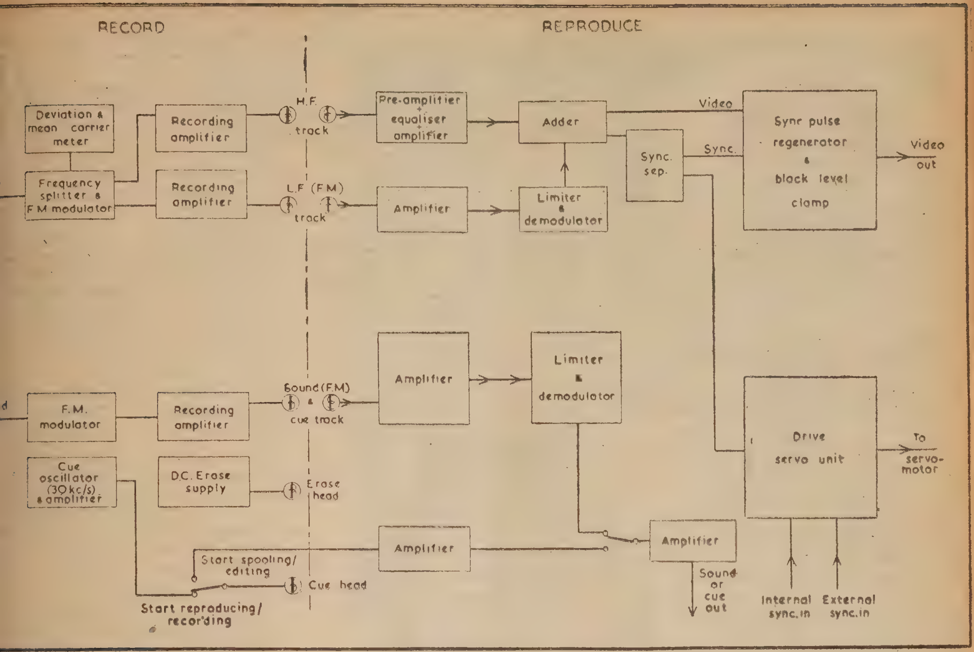
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Video
Sync.
Sync. sep.
Sync pulse regenerator & black level clamp
Video out
d
F.M. modulator
Recording amplifier
Sound (F.M.) & cue track
Amplifier
Limiter & demodulator
Cue oscillator (30kc/s) & amplifier
D.C. Erase supply
Erase head
Drive servo unit
To servo-motor
Start spooling/ editing
Amplifier
Amplifier
Cue head
Start reproducing/ recording
Sound or cue out
Internal sync. in
External sync. in

Block schematic of principal electronic units

signal. Separate recording and re-
cing head-stacks are employed,
stack containing three identical
separated from each other by cop-
creens and aligned to the accuracy
ed in the manufacturing process.
nuous monitoring of the recorded
during the process of recording
be carried out.

NSPORT SYSTEM

the tape transport system embodied
e machine most of the power re-
d to drive the tape is supplied by
pooling motors which are arranged
ove the tape past the heads at a
just below the chosen recording
of 200in/sec and close to the con-
tension required, even when the
motor is not engaged.

s result is obtained by varying the
fed to the spooling motors in ac-
nce with (a) their torque/speed
cteristic and (b) the amount of tape
e reels at any particular moment,
tter determining the speed of ro-
required of the reels. When the
is engaged the drive motor is,
ore, required to supply only a
d amount of power to bring the
speed up to 200in/sec.

e drive is engaged by lowering two
r idlers on to a common capstan
at a loop of tape, largely isolated
transient effects in the reels by
idlers and other mechanical filter-
ements, is formed. Inside this loop
e recording and reproducing head
s.

e erasing head is placed at a con-
nt point which lies outside the loop
precedes the recording head.

"Velodyne" system of speed con-
and correction of the driving cap-
is employed. During recording
ds the servo driving motor is made
ronous with the mains frequency
on reproduction the output of the machine is frame-synchronised to station synchronisation signals. The machine is fitted with the usual facilities for braking and for spooling the tape backwards or forwards at a variable speed when the drive system is not engaged.

A block schematic diagram showing the connections of the principal electronic units embodied in the machine is shown here. For storing the video signal the two video tracks are associated, on the recording side, with a band-splitting system in which the video signal is divided into two frequency bands of approximately 0-100 kc/s and 100 kc/s-3 Mc/s. The 0-100 kc/s video band is made to frequency-modulate a carrier and this frequency-modulated carrier is recorded on one track.

The low-frequency content of the video signal is thereby transferred to a frequency band corresponding to shorter wavelengths so that both the low-frequency and the long-wavelength difficulties inherent in the conventional magnetic-recording system are avoided.

LIMITING CIRCUITS

In addition, the amplitude-limiting facilities normally associated with the reception of frequency-modulated signals may be incorporated in the reproducing chain to eliminate undesired amplitude fluctuations and overcome almost all "drop-out" difficulties, even when employing thin-base sound-recording tape not specifically manufactured for video or instrumentation purposes. The higher vision band, from 100 k/cs upwards, is recorded simultaneously on the second video track in a conventional manner.

On reproduction the output from the frequency-modulated video track is limited, demodulated, and added to the output from the higher-frequency track to reform the composite television waveform. Before transmission to line the synchronisation information, including line and frame synchronising signals and suppression periods, is extracted, reconstituted and added back into the video signal.

HF BAND AFFECTED

It is, of course, obvious that the higher-frequency video band, which employs a conventional recording/reproducing system, will be subject to the same unwanted amplitude-modulation which is being eliminated by the frequency-modulation system of the lower frequency video band. It is, however, an important finding that in practice this does not appear of major importance, for as long as the synchronisation signals and the main brightness structure of the picture, represented by the 0-100 kc/s band of the video signal, are maintained intact, reasonable variations in the higher-frequency band do not noticeably degrade the subjective result.

All the low-frequency and long-wavelength difficulties which, in the case of the lower video frequency, are overcome by the use of the carrier system, will also be manifest in the sound channel if a conventional recording of the sound signal is attempted under the higher tape-speed conditions dictated by the video-signal requirements. The difficulties are, however, overcome by an identical technique to that employed to store the lower video frequencies. Accordingly the sound signal is, before recording, made to frequency-modulate another carrier which is recorded on the third track. On reproduction the carrier is limited and demodulated to provide a sound signal of high fidelity exactly synchronous in time with the video information reproduced from the other two tracks.

As in other forms of picture or sound

(Continued on Page 85)

For nearly 40 years, the skull of the "Piltdown Man" was thought to be a relic 600,000 years old, unearthed in Sussex in 1912. In 1949, a dentist of Clapham suspected that it was not genuine, and a fluorine test verified the suspicion. It was a hoax—the skull may date back 50,000 years, but the jawbone came from a modern ape, stained and treated to simulate antiquity. Here is the dentist, Alvan T. Marston, with the skull.

Science Is Helping Archeolog

Modern archeology is now a more exact science thanks to the assistance of physics, chem istry, geology and astronomy. By the application of modern techniques some astonishin things have been found concerning ancient relics.

by Calvin Walters

IN the wastes of the African jungle, in the burning sands of deserts and the thick forests of Mexico, men and women are daily risking their lives against fevers, wild animals and reptiles, digging and seeking for relics of civilisations and peoples of ages long past.

Some time ago I asked one of these people why archeologists undertook such hazardous occupations and, of course, I got the usual reply of "thirst for adventure" and so on. To an archeologist the seeking of lost temples and buried cities has the same appeal as the climbing of Mount Everest had to Sir Edmund Hilary.

I suppose it is all right for those who like that sort of thing, and it is probably just as well that there are people like that.

But not for me.

If I am to do any digging I pref the safety of my own back yard, a even that is a hazardous occupatio Think of all the risks of backache f one thing. Why, it could be quite ea to slip a disc in the spine. One cou easily run a garden fork through on foot. Blisters could easily become sept and one could then die of blood poiso ing if it happened to be a Sunday a no doctors were around and the car w out of order and the ambulance was t busy to come and you couldn't get a hospital. All those risks for a f measly flowers or some cabbages whi can usually be bought for a quarter t price that they cost to grow taking i consideration time, labour and insec cides.

One house I lived in must have be built on the site of an ancient garba dump. Every time I tried to dig garden a lot of things came up tha never planted in the first place. T experience made me very cautious all time. Nowadays I find it much sin ler to sit at my typewriter earning few measly "bob" which the Editor luctantly pays me and which I pay to the poor bloke who now excava in my back yard.

ANCIENT STUDY

The term archeologist has noth to do with feet. The man who lo after your arches is a chiropodist, the same as a fishmonger is a fish gist or a fyshician.

The word archeology was deri from the Greek word "arkhaios" me ing "ancient." So the word archeol means a study of human antiquities the art, customs, and beliefs of the n ancient peoples.

A little over a hundred years the belief was widespread that world came into being somewhere ab 4004 B.C.

I am not going to buy into any a ments about this. People have their opinion on these matters. This is article on the science of archeo and I will merely propound the pr ples on which that science is based leave it to my readers (if any) to lieve it or not.

But PLEASE don't get me into arguments about religion versus sc and start writing letters telling me an atheist or something. I am m an "artologist" (one who writes arti

Somewhere about the year geologists began to learn more the formation (not the creation) o earth. Investigation showed that it made up of a series of layers of gravel, sand, clay, decaying or de vegetation and so on. They called

"strata" and a study of the manner
ich similar layers are formed today
some indication as to how pre-
ones were formed many ages ago.
ht through a series of cataclysms
which the earth began to solidify
a mass of whirling gases, it was
essively subjected to violent con-
ons and upheavals. As the earth
l, the land masses were in turn
ed by masses of ice which ground
way over the surface and left marks
walls of deep valleys and ravines.
floods and alternating periods of
and heat all left evidence in the
of silt and rock, clay and sand,
were deposited by these upheavals.
the geologists have divided these
into periods, which they have
ied into a "geological time" scale
ning about 2,000 million years ago
the Pre-Cambrian period layer.
is deep down in the earth below
) feet and is of unknown thickness.

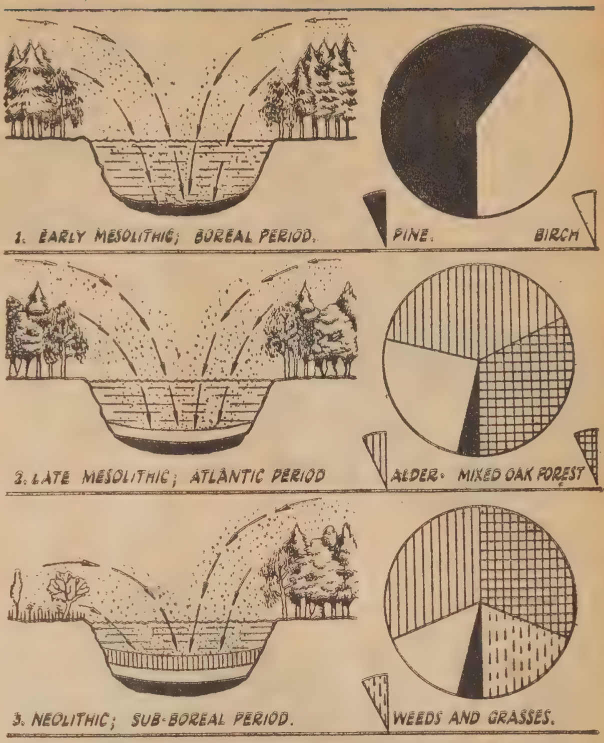
LIEST TIMES

ove this is the Cambrian layer of
) feet thickness deposited between
and 520 million years ago. Then
is the Ordovician, of 40,000 feet
ess, deposited between 350 and
nillion years ago. Next the Silurian,
) feet, 320-350 M. Y. A. (million
ago), the Devonian, 37,000 feet,
20 M.Y.A., followed in turn by
Carboniferous, Permian, Triassic,
sic, Cretaceous, Eocene, Oligocene,
ene and the Pliocene. The last four
g to what is termed the Tertiary
l and were formed between one and
y million years ago.
Pliocene layer is about 18,000
hick, formed one M.Y.A. Above
ayer are the Pleistocene and Holo-
about 4,000 feet thick. Concerned
this is the period up to 500,000
ago called the "Quaternary" or
Age Of Man, for, it is estimated
t was during this period that man
to occupy the earth.
w the question is, "How much of
stimated age of each layer is guess-
and how much truth? On what
eologists base their estimates?"
us go a bit further into matters.
t 600,000 years ago, according to
eologist, a series of changes took
which were called collectively the
Age. Four times during that period
greater part of northern Europe,
and America was covered in vast,
ice. The huge glaciers below the
round their way southward carry-
with them the crushed rocks and
which they ground out from the
of the valleys which they formed.
rocks and material were deposited
rn along the sides of these valleys.

T FLOODS

en, as the ice period ended, the
ers melted and the resulting floods
d vast quantities of soil and silt
gravel which were deposited on the
of the valleys.
us there were four periods, at least,
ld and ice alternating with warmth,
is lapse of 600 million years.
ring the cold periods, cold-loving
ures came south with the ice. Dur-
he warmer periods they retreated
, and warmth-loving creatures came
regions which were previously cold.
their remains lie in the various
left by the four glacial periods

POLLEN DEPOSITS WRITE HISTORY


1. EARLY MESOLITHIC; BOREAL PERIOD.
PINE.
BIRCH
2. LATE MESOLITHIC; ATLANTIC PERIOD
ALDER.
MIXED OAK FOREST
3. NEOLITHIC; SUB-BOREAL PERIOD.
WEEDS AND GRASSES.

Pollen analysis—the reconstruction of ancient vegetation. Left—The formation of pollen deposits at the bottom of a lake. Right—Pollen spectra in which different forms of vegetation are expressed as percentages. The change from 1 to 2 is caused by increasing warmth of climate. That from 2 to 3 is due to man's forest clearance for agriculture, marked by the appearance of weeds and grasses. (From "Down to Earth").

as mute evidence of the fact that the four Ice Ages did in fact occur.

Now, about this time factor. In igneous rocks, which are rocks created by fire or heat, there are certain radioactive minerals. At a specific stage of cooling these minerals begin to radiate and change into a new substance. This change occurs at a constant rate. Uranium, for instance, eventually changing into lead.

Where these minerals have been found in the various layers, the time taken for them to turn into lead can be calculated and translated into terms of millions of years. This will be the time which has elapsed since those rocks were formed.

This method is very important where igneous rocks have intruded themselves, when in a molten state or by pressure, between two layers of sedimentary rock which might contain fossils of creatures or plants.

SETTING DATES

It will be seen that, if it is possible by means of radio-activity to date the igneous rock, the surrounding rocks and fossils will also be automatically dated.

When the ice retreated at the end of the last ice period, trees and other vegetation began to spread to the north once more. The end of the last glaciation of the ice age has been fixed at 7900 B.C., and as more and more bare land was exposed it became covered with vegetation because of the seeds which were carried on the winds.

An ingenious method of "pollen analysis" has been devised by means of which scientists can tell what plants were growing at any particular period and thus an estimation of the temperature can be made.

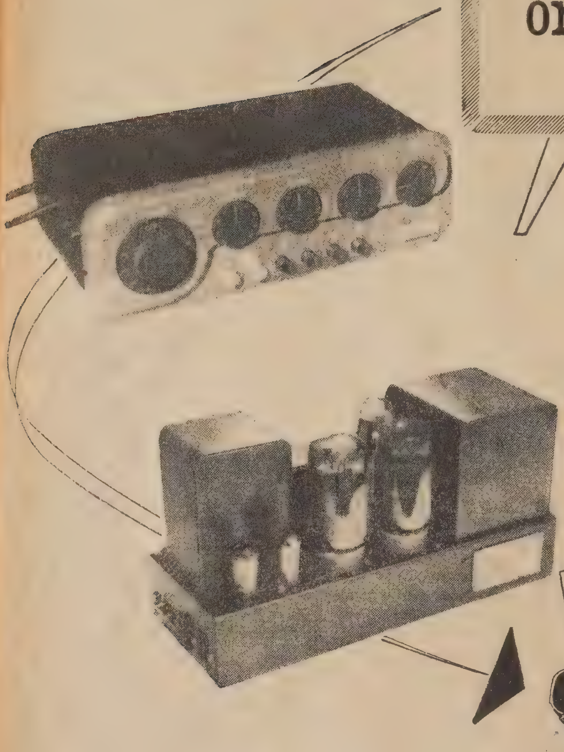
POLLEN DEPOSITS

The air at all times contains countless millions of grains of pollen from plants. These not only settle on the surface of the earth but also float on the surface of lakes and finally sink to the bottom.

Circumstances often allow the pollen grains to survive, and if they are taken from the bottom of a lake they can be recognised as pollen from a given plant.

Prehistoric lakes therefore can be expected to contain layers of pollen of the

for the closest approach to the original sound



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RH/6/5

A BRITISH MERCHANDISING PTY. LTD. AGENCY s which existed at any given period was found to be the case.

taking, in a specially devised tube, umn of samples of the layers from ottom of a prehistoric lake in the of Europe, the scientists found in ower layer pollen from trees and es that thrive in cold places and were deposited by the water from nelting glacier. The upper layers ined deposits of pollen of plants grew in warmer climates. The top layer contained pollen of which thrive at the present time. calculate how long it took for changes to take place, geologists e fact that the water from melting rs which flow into lakes carries during spring floods which settn the bottom of the lake in dis layers.

coarse gravel settles on the bot- and the finer gravel above, with layers being added after every flood.

ER METHODS

Swedish scientist discovered that tain lake in Sweden had been d in the year 1796. By working from that date he was able to ate the position of the edge of acier for each successive year. He dated the various forests which on the shores as the climate be- warmer when the ice retreated.

onomy has also been brought into atter to calculate back and find regularities in the solar system scientists hold responsible for rious Ice Ages of the earth.

en archeologists find some old at a site great care is taken that estimates and analyses are taken any pronouncement is made re- g the age of the find.

tomy plays a great part in this, e the study of bones of present eople compared with those of who existed during the periods itten history quickly reveals any nce with those dug up from any site.

mentioned above the method of rocks also helps in dating any embedded therein.

ever, a recent method called the e test" can prove whether bones together in the same site are of origin which have become mixed d or other disturbance with bones ater age. This is important be- such cases could easily occur.

etimes careless excavation at a uld cause a fall of upper layers into lower layers and the two hopelessly mixed.

VATION CARE

disconcerting it would be to find broken pieces of a gramophone of Elvis Presley which someone desperation, smashed up, mixed emains of a dinosaur which ex- housands of years ago.

as been found that the longer a ies in the earth the more of the element fluorine it absorbs. also tend to lose nitrogen the old- are. Thus the longer they have uried the more fluorine and the trogen they contain.

her test applied to remains of living things is the Radio-active Carbon test. This substance which comes from outer space is absorbed by living things plant or animal. Upon death the content of radio-active carbon decreases at a constant rate ultimately being reduced by half in 5,700 years. Special instruments can measure the amount of radioactive carbon remaining in the relics of living things, and by comparison with comparable items of modern times, calculations can reveal how long ago death took place.

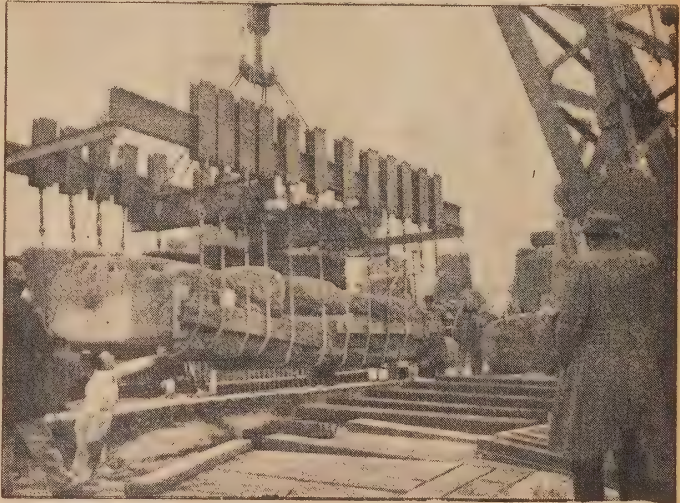
When searching for sites in which to dig, aerial surveys play a very important part. Sites which have been otherwise obliterated may become quite visible when viewed from the air.

Photographs are usually taken at sunrise or in the evening when shadows are longest. In this way burial mounds which have been flattened by cultivation will cast shadows which are visible on a photograph from the air.

An extraordinary feature of aerial photography is that ancient ditches which have been filled in become quite visible. The greater depth of soil in the

(Continued on Page 121)

The ancient structure of Stonehenge, one of history's wonders, dates back nearly 4,000 years, and is apparently a sun-worshippers' temple erected by a long-vanished race. The big sarsen stones are more than 16ft. high and weigh over 50 tons. No one knows how they were erected, or transported 200 miles to the plains of Salisbury. This picture was taken during the snows of 1957.



The Department of Works is endeavoring to raise fallen stones at Stonehenge into their original positions. Here a 60-ton crane lifts stone 58 from a hole. It is one of the uprights of a Trilithon and has lain half buried for many years. Radio-active tracers were used to test the condition of a crack in the stone before it was lifted. The lump on the end is part of a mortice and tenon joint which fitted the lintel resting on each pair.

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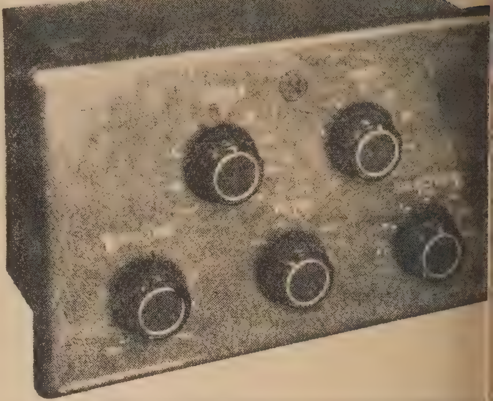

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Technical Review

TECNETRON — COMPETITOR OF THE TRANSISTOR?

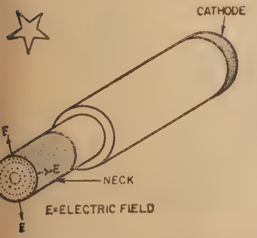
his article originally appeared in Tout le Radio, a French journal pub-
shed in Paris by M. E. Aisberg wh o prepared it. The device describ-
d, neither a spacistor nor a transistor, shows the greatest promise on
ultra-high frequencies.

rdly a month passes nowadays with-
he announcement of some "sensa-
l" new amplifying device. The great
rity of these startling inventions,
their brief flurry in the popular
technical press, disappear into ob-
. But we believe that the Tecne-
just announced in France, has a
nt and enduring future.

e most remarkable feature of this
e is that its transconductance in-
es with frequency, unlike more com-
semiconductor amplifiers whose per-
ance falls off as frequency increases
ecomes very low as the cutoff fre-
y is approached.

to the present, frequencies in the
of 500mc have been attained with
Tecnetron. And, as further work
research make it possible to reduce
pacitances of the contacts and other
of the montage, there seems to be
g to prevent it from functioning
00mc or even higher.

as been possible—with a Tecnetron

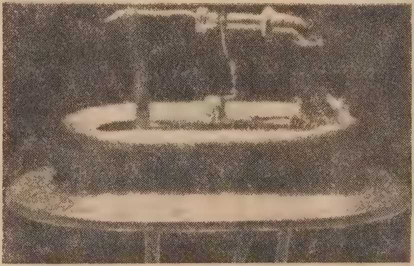


1--Tecnetron cut to show cross
ion of the neck. The space charge
ends to drive the conducting area
toward the centre of the rod.

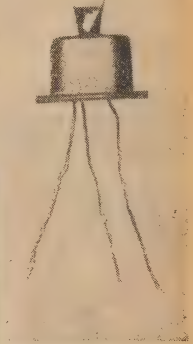
ing in class A at 500mc—to ob-
a power output of 30mw, with a
ation of 125mw. Since the char-
stics of individual Tecnetrons are
consistent, one can envision the
leling of several identical units to
n watts—or even kilowatts—of
r. This may make it possible to use
etrons in applications requiring
currents.

addition, the Tecnetron—though
germanium—is less sensitive to
temperatures than the transistor.
ll operate at temperatures 20 de-
Centigrade higher than will tran-

Below—A close up view of the Tecnetron the construction of which is not the same as that of the transistor.



Right—The Tecnetron as finally made up in its metal case with connectin wires



sistors. This should extend its field of applications considerably.

Neither is it a fragile experimental device that works only under laboratory conditions. Pilot production by regular industrial methods had begun on a small scale at the time of its announcement.

About 700 units per month are being produced, and indications are that production could quickly be increased to the thousands.

WHAT IS THE TECNETRON?

First, why is it the Tecnetron? The first syllable of the name begins as does that of its inventor, S. Teszner. The initials CNET follow. These stand for the Centre National d'Etude des Telecommunications (National Centre for the Study of Telecommunications), that great ensemble of research laboratories sponsored by France's Ministry of Posts, Telegraphs and Telephones. And of course the final syllable is the conventional one for such electronic devices.

Now, how is the Tecnetron constructed? It is a small rod of n-type germanium, 2mm in length and 0.5mm in diameter, provided with two contact electrodes at the ends. These must be of such material that they act solely like electrical conductors and not like transistor junctions.

The germanium rod is reduced in diameter at its centre (Fig. 1) to form a "bottleneck" of very small diameter (about 30 microns). Around this neck is placed a cylinder of indium. This makes a metal-to-semi-conductor barrier-layer contact of excellent characteristics. The ratio of forward-to-back resistance is greater than a million to one.

A relatively high potential (50 volts or more) is applied to the electrodes at the end of the rod. These may be called the cathode and anode. The cylinder of indium might be called a grid, for it plays exactly that role. The inventor prefers to call it the "bottleneck" or simply the "neck" to indicate its method of action better.

The neck is polarised negatively with respect to the cathode, and the circuit of a stage of amplification (Fig. 2) is like that of a tube triode, with the load resistance placed in the anode circuit in series with the supply voltage.

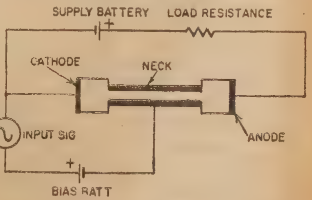


Fig 2—Schematic of Tecnetron hook-up.

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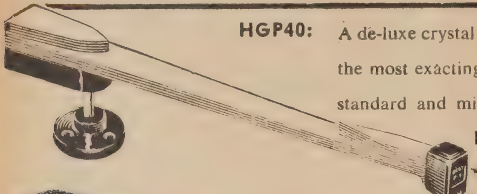

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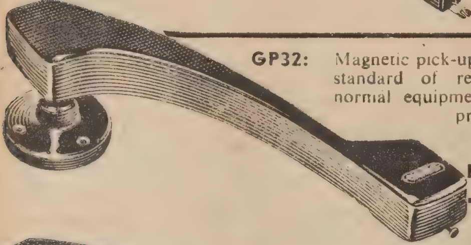

GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at reasonable price Output voltage, ¼ volt at 1,000 c.p.s.

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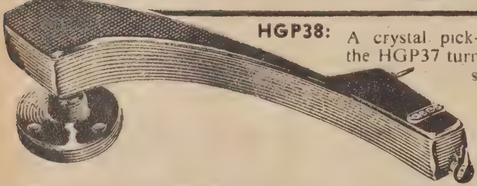

HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus.

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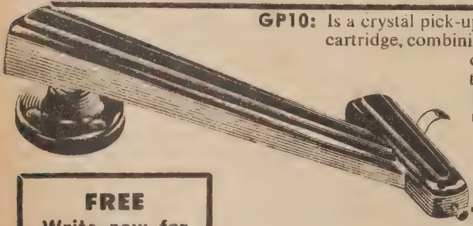
GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through *low-gain* amplifiers as used in small record players and some radios **PRICE, £4/19/6**

GP60: Incorporates the latest-type CERAMIC cartridge—unaffected by heat or humidity For use in tropical areas **PRICE, £6/16/-**



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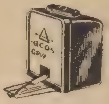

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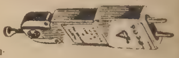
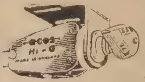


GP9 CARTRIDGE

Now famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records. **PRICE, £1/11/6**



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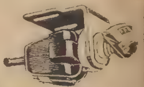

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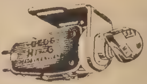

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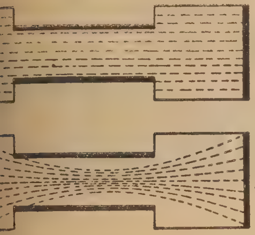
nis device not essentially that which ley called a "field-effect transistor" he described in the Proceedings of RE (November, 1952; Vol. 40, pp. 76) and with which he was not able ain appreciable gains above 2 mc? Shockley, Teszner has turned to the effect, discovered by Lilienfeld in Here the resemblance ends.

ereas Shockley worked with plane es (or a parallelepiped), Teszner ilised the cylindrical configuration,



3a—Distribution of charge carriers ctrons) with neck unbiased; 3b—ction of current path caused by negative bias on the neck.

orming a linear effect to a quadone by applying a radial electric

at is the field effect? Our readers of the Hall effect, due to which carriers in semi-conductors can lected from their paths under the of a magnetic field. The Lilienfect is analogous to the Hall effect, based on the action of the electric d of the magnetic field.

emi-conductors such as germanium, carriers (electrons or "holes") can flected from their paths by the of such an electric field.

TECNETRON ACTION

neck of the indium cylinder s a concentrated electric field in terior o fthe rod, depending on harge on the cylinder. With no whatever, the current is propaevenly through the whole area of eck. As one applies a negative e to the cylinder, the electrons are ed toward the centre, occupying reduced section of the rod (Fig. hus the apparent resistance of the ncreases as the active section—h which electrons pass—decreases. ction is proportional to the square radius.

e well that this is a variation in tal resistance, not in the specific vity which remains constant.

voltage applied to the indium cylcauses the neck to act as if its ter were decreased. Thus the cathode current is varied, causing the e across the load resistor to rece faithfully the changes in the e applied to the neck, but at a r amplitude.

best analogy of the Tecnetron is it doubt a flexible rubber hose h which flows a current of water. hose is compressed more or less hand, the flow decreases in the ratio. If the hose is compressed arly—from all sides toward the , as by an encircling thumb and ger—the diminution of current will the square law. This centripetal constriction is an essential characteristic of the Tecnetron.

If we analyse these actions carefully, we note that the variation in resistance is accompanied by a variation in capacitance between the part of the germanium occupied by the electrons and the indium cylinder.

As the cylinder becomes more negative, it drives the electrons further from it and toward the centre of the rod, thus reducing the capacitance between the current-carrying portion of the rod and the cylinder.

As the voltage becomes less negative, the electrons flow through a larger section of the germanium and the capacitance increases. The Tecnetron acts like the equivalent circuit of Fig. 4.

These variations of capacitance, which are increased by the cylindrical configuration of the device, have an effect on the current through the external circuitry similar to that which the variations of resistance have on the flow of electrons through the germanium.

These two actions are synchronous and reinforce each other, thus increasing the gain. There is of course a very slight detuning effect in resonant circuits due to the instantaneous variations in capacitance produced by the signal. These are very small, since the total input capacitance is a fraction of a micromicrofarad and the detuning is proportional to the square root of the capacitance change

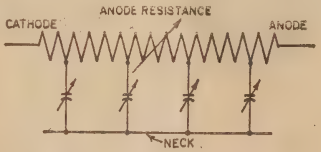


Fig 4—The Tecnetron can be considered as a variable resistance and a distributed variable capacitance.

Practically, according to the inventor, it manifests itself as a slight enlargement of the passband.

The capacitance effect, with its reduction of impedance as frequency increase, is one of the reasons for the high transconductance at high frequencies (Fig. 5) and the fact that the Tecnetron's figure of merit continues to increase with frequency. The figure of merit is the product of the gain by the width of the passband over which the gain is maintined at plus or minus 3 db.

TECNETRON AS AMPLIFIER

We have seen that the neck which acts as a control electrode is polarised negatively with respect to the cathode. Thus no appreciable direct current can flow in the cathode-neck circuit, because of the extension of the barrier layer into the n-type germanium.[1]

Under these conditions, the input resistance is several megohms. The input capacitance is in the order of 2 uuf.

The output impedance is generally higher than 1 megohm, and the load resistance thus may be chosen as high as it is practically permissible to set it; usually between 2,500 and 250,000 ohms.

If we plot the characteristics of the Tecnetron by measuring the anode current as a function of the anode-cathode voltage at various values of neck voltage, we obtain a family of curves which resemble strikingly those of a pentode tube (Fib. 6). Which is to say, that we have here an excellent voltage amplifier. The chart shows experimental results obtained at various frequencies.

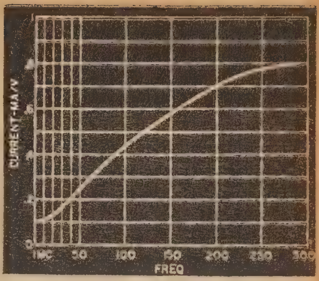


Fig 5—Variation of the transconductance as a function of the signal frequency.

MANUFACTURING THE TECNETRON

It was necessary to develop special technical methods to manufacture the Tecnetron. This was one of the major achievements of M. Teszner and the CNET researchers who aided him.

For part of the work, the classic procedures of transistor production could be followed. Then, a whole series of new mechanical operations intervened; cutting the refined crystals into plates, then into little rods. This last operation was performed with ultrasonic cutting apparatus.

The constriction for the neck was made by a procedure of electrolytic etching perfected especially for the purpose. The indium was also deposited by electrolysis, with the rod in continuous rotation during the process. More conventional techniques could be used in applying the terminal (cathode and anode) contacts.

Up to the present, procedures already developed permit manufacture on a large scale. Research is continuing, however, and the next step is the creation of a power Tecnetron and another model especially for ultra-high frequencies. Special arangements which will permit continuing still further up the frequency spectrum are also under study. And, as always, as the area of actual accomplishment is increased, the greater become the prospects of future progress.

—Radio Electronics

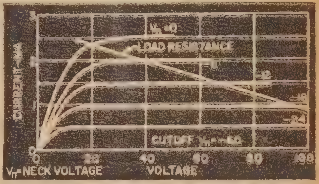


Fig 6—These Tecnetron static characteristic curves show the variation of anode current as a function of anode voltage for several neck voltages.

Freq. (mc)	Gain (db)	Voltage ratio	Passband (mc)	Figure of Merit
110	22	12.9	1.7	21
200	16	6.31	6	37
460	9	2.818	29	80

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otary-axial tuner consists of two pairs of ferrite cups with
ound D-shaped centre cores ganged to produce linear fre-
uency variation from 500 to 1,600 kc with mechanical
otion. Operating frequencies can be extended to 15 mc.
ning sensitivity is reduced as each band is covered in
0-degree rotation rather than in the 180 degrees of
normal capacitor tuning.

WTH in transistor use has spurred e search for miniature electronic s.

iaturisation of an r-f tuner opera- etween 0.5 and 50 mc can be ed with permeability rather than tance tuning. Further, permeabil- ning is free from vibration and troubles. A linear, permeability ner is described for which a 3 to 1 ncy range, maximum Q and mini- variation of Q with frequency are ed to be desirable.

ent tuners may be classified as ners, gap tuners, variometers and hat vary the number of turns on a

ermeability gap tuner is the best omise between electrical and mech- considerations. It uses the relative of two ferrite cups or a ferrite nd cover plate or two C-shaped Although the core material is al- within the coil, the inductance is by changing the size of a gap magnetic-field path.

ap tuner is shown in Fig. 1A. The technique permits miniaturisation he cover movement does not ex- /8-in. for a 3 to 1 frequency range.

-LINEAR

uency variation with cover move- is nonlinear. A 250-kc change in the first 10 mils of travel, and upper end of the band, a 10-mil may cause a 25-kc shift. A pre- echanical drive system is required trol the complete frequency range /8-in. travel.

ther gap tuner is shown in Fig. 1B. entre section of the cups has the of a D. Rotation of one cup with to the other changes the effective ngth. Frequency changes of 2 to feasible with this device. Further- since the complete frequency range covers a long rotary path the mechanical drive system is not critical.

The rotary-axial gap tuner takes advantage of the slow frequency variation of the D-type tuner and the wide frequency variation of the cup and cover-type tuner. It consists of two pairs of ferrite cups with ground D-shaped centre cores.

Tuner operation is described in the curves of Fig 2. Curve 1 is the frequency response obtained upon rotating two ferrite-cup cores with D-shaped centre cores without gap separation. Frequency initially varies slowly as the cups are rotated, increases to a maximum when the D figures are mirror images at 180 deg. and then decreases slowly. The curve is bell-shaped.

When separating two ferrite-cup cores without rotation, curve 2 is the frequency response obtained. The frequency varies rapidly and then reaches a point where increased gap separation has no effect.

When a tapered coil is used inside the core, the frequency response of curve 3 is obtained. Saturation frequency is 100 kc higher than in curve 2.

Composite curve 4 is obtained when both rotation curve 1 and axial-movement curve 3 are combined by a cam. Since the gap separation is small, rotation of the cup initially exerts the greater control over frequency. Therefore, the frequency varies comparatively slowly.

MECHANICAL PATH

During the first 250-kc change there is a long mechanical path of rotation rather than a short mechanical path of axial movement. As the cups are rotated 180 deg. with respect to each other, the gap separation increases until the D-shaped centre-core separation no longer affects the frequency change. Thus, the right half of the bell-shaped curve has no effect on the frequency. Beyond 180 deg. the frequency change results from gap separation, although the cups continue to rotate with respect to each other. The resulting curve 4 has a linear frequency variation from 500 kc to 1,600 kc.

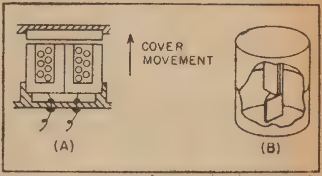


Fig. 1 — In gap tuner (A) inductance is varied by changing gap size in magnetic field path. Rotation of one cup of D-type tuner (B) with respect to the other changes length of the gap.

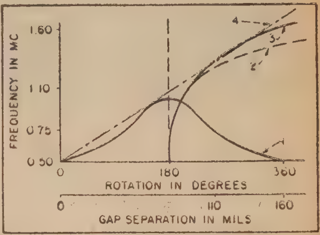


Fig 2 — Curve 4 is the linear frequency response of the rotary-axial tuner obtained by combining responses of curve 1 for D-shaped centre cores without gap separation and curve 3 for a tapered coil within the core.

By further tapering the coil the frequency range may be extended linearly to 1,700 kc. Maximum possible Q is 151.

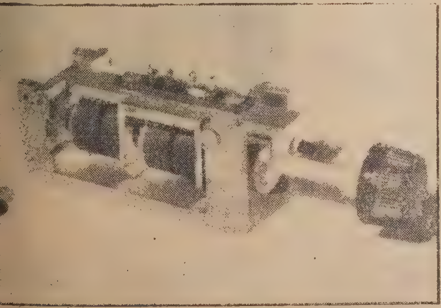
MECHANICAL DESCRIPTION

Axial motion of the cups is caused by the cam shown in the turner drawing of Fig. 3.

A cam follower is in contact with the cam. After adjusting the cam follower to provide initial positioning, it becomes a fixed element of the follower housing and provides linear movement of the axial cups in accordance with the cam form.

Linear motion of the axial cup without backlash is provided by a spring.

The portion of the shaft which is in



ary-axial tuner size A is indicated by comparison with transistor.

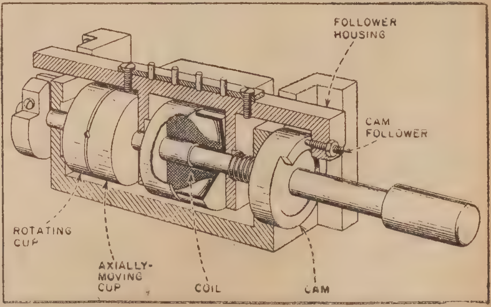


Fig. 3 — Cutaway view of rotary-axial tuner shows parts.

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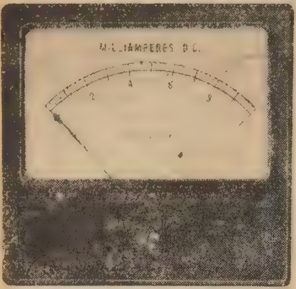
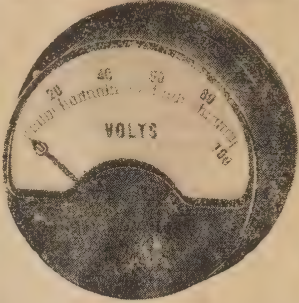


PANEL METERS. A comprehensive range of both moving coil and moving iron types are available in 2", 3", 4" round, square, rectangular and polystyrene meters. Ammeters, voltmeters, m.a. meters, micro-ammeters, VU meters, etc.



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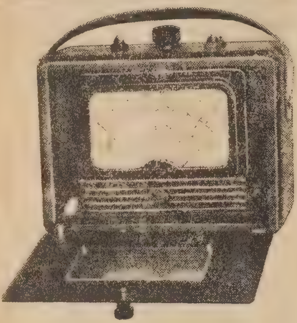

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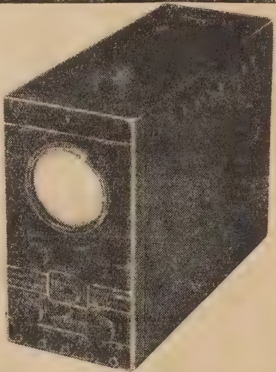

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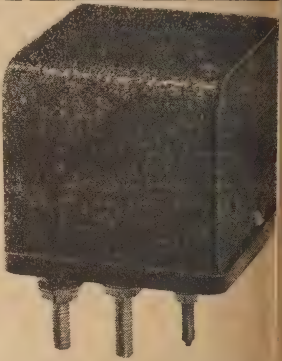

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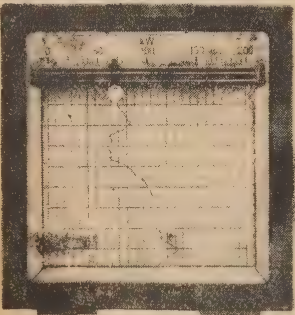

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NIATURE TUNER USES FERRITE CORES

(Continued from page 25)

mediate area of both rotating and ups is made of a dielectric mate-

ee-point tracking of the r-f coil is ed by placing shunt and series together with a new tuning capa-, in parallel with the r-f coil. A oscillator-frequency range results cillator tuning follows the r-f tun- rve as shown in Fig. 4.

show the application of the tuner nsistorised circuits, the tuner r-f connected by a capacitance divider input of the transistorised mixer shown in Fig. 5. Mixed output d tuned with a coil resonant at .

oscillator coil of the tuner is con- through two trimmer coils to the or of transistor Q2 which acts as a oscillator. The oscillator signal acitance-coupled to the emitter of ixer stage.

r making adjustments for stray tance, the tuner operates with the ty and tracking characteristics of .

ers covering the ranges 1.5 to 5 id 5 to 15 mc have the same ncy slope as the broadcast-band and therefore can be used with me cam. When the coils are suc- ly tapped down after each rota- f the cam, a semi-continuous tuner constructed. A coil wound with taps is placed in ferrite cups ested in an r-f tuning jig. The from 0.5 mc to 1.5 mc and from c to 5 mc are easily covered by g down the coil. The highest band an upper-frequency limit of 7.3 The total frequency ratio obtained 6 to 1 with the same turner.— onics.

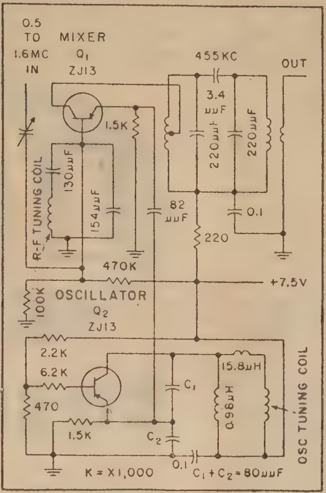


Fig. 5. — Transistorised circuit checks RF tuner whose linearity and tracking characteristics are shown in Fig. 4.

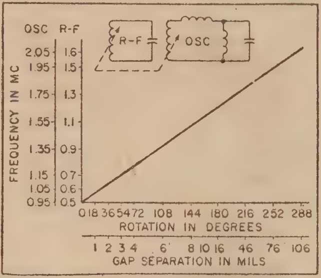


Fig. 4 — Straight-line tracking is achieved with rotary-axial tuner.

BIG ELECTRONIC PLAN FOR CITIES IN U.S.A.

Electronic systems such as VHF radio and automatic electronic control are being adopted on a wholesale scale overseas. For Philadelphia is planned the largest mobile radio system yet installed. Detroit plans traffic control aids.

Two cities—Philadelphia and Detroit—are making news these days.

Philadelphia recently invested $600,000 for what police officials call "the most extensive system of microwave communication in municipal use." Project will be done by RCA.

The system will include four primary and 12 secondary base stations, all attended. They are designed to be multiplexed in varying combinations to blanket the city. Special alarm systems for failure detection will be provided.

Mobile units will include 570 two-way radios and 250 public address amplifiers in patrol cars and other vehicles.

Unique features of the system will be a punch-card centre for recording and routing incoming calls, and a display board indicating location and availability of police vehicles.

This combination will allow central control dispatchers at city hall to send a patrol car to any location within seconds of receiving calls.

Installation of the system was begun this month. It is expected to be in full operation by mid-June.

WARNING SYSTEM

In Detroit, a new system for warning expressway drivers of impending danger through a series of electronically operated signs that flash traffic messages is now being drafted by the city's department of streets and traffic. The proposed experiment would cost more than $100,000.

The system would call for the signs to be built on the faces of expressway bridges where they would be used to warn drivers to slow down or leave the expressways.

The signs would be operated electronically from a central control room, which probably would be located in police headquarters. Blacked out when not in use, the illuminated signs would flash such messages as "Troubles Ahead," "Speed Limit 30" or "Use Next Exit." All three of any combination of the messages could be flashed simultaneously.

BBC TELEVISION CENTRE TAKES SHAPE

KS and concrete are rapidly covering the vast skeleton of the Television Centre in West Lon- hich when completed will be the television headquarters in Europe.

en BBC Television—the oldest television service in the world— pened on November 2, 1936, it ed from two studios, small by n standards, in the exhibition ng called Alexandra Palace in London, and through all the of its enormous expansion it has had a headquarters built specially levision and capable of housing lk of its requirements under one

new Television Centre stands thirteen-acre site, acquired by the in 1949, and will consist of an ssive Main Block containing seven s and several hundred offices; a y Block, which has been in ser- r some years and includes work- storage space for scenery and about 200 offices; a Restaurant Block now being fitted out to accommodate 750 diners at a sitting; a Works Block; and eventually a "spur" or "tail" running out from the Main Block. The total cost, over eleven years, will be £9 million pounds sterling.

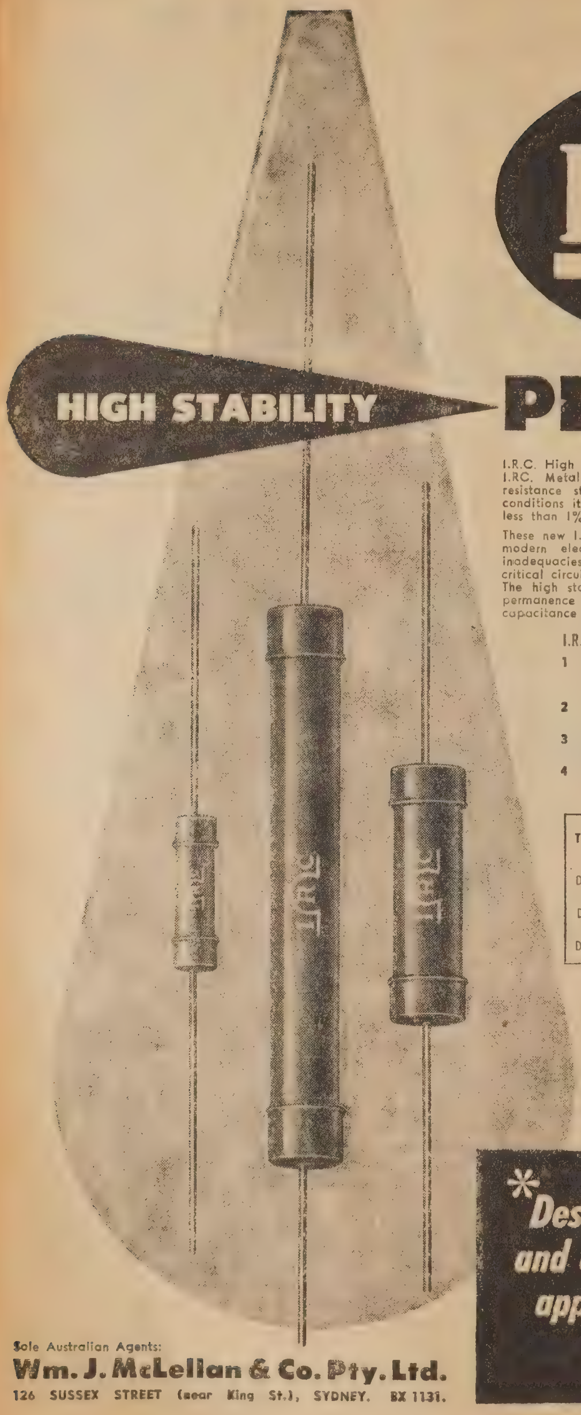
Four of the seven studios will be bigger than any television studio now in use in Britain and the largest (measuring 108 feet by 100 feet by 54 feet high) will have a pit which could be used for aquatic programmes, and a floor designed to carry heavy loads—for example, double-decker buses or parades of elephants. It will accommodate an audience of 600 people.

Each studio will have its air conditioning plant, and the studios have been so planned that they can be adapted for colour transmissions when these become practicable. It is expected that four of the studios will be in use in 1961. In addition to studios, there will be 120 dressing rooms on the ground floor and basement providing accommodation for about 550 people.

The Continental Control Point for Eurovision programmes shown on BBC television, which is at present at Broadcasting House, will also be housed in this "central wedge," while on the roof of the section there will be facilities for outdoor filming.

Offices, Wardrobe and Make-up Sections, the Music Department, and the club premises for BBC staff will all be included in the Main Block, on which 700 men are at present at work.

The block will contain 8 million bricks, 4,300 tons of steel, 2,500 doors and 55,000 tons of concrete. During construction concrete, already mixed, is being delivered by pipeline under air pressure all over the structure from central mixing points.



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DCC	½-watt	75 ohms to 2 megs.	9/16"	5/32"	[illegible]
DCF	1-watt	150 ohms to 3 megs.	29/32"	19/64"	[illegible]
DCH	2-watt	300 ohms to 5.1 megs.	2-1/16"	19/64"	[illegible]

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NEWS AND VIEWS OF THE MONTH

ssian nuclear plane

PORTS indicate that Russia is planning to put a nuclear plane the air this year.

secret four-jet bomber, a new ver- of the unsuccessful Bison, is being ted to carry a nuclear engine.

eportedly heading the Soviet nuclear power team is a former Cambridge essor, Peter Kapitza, the master- d behind the sputniks.

e went over to the Russians from Cambridge laboratory in 1935.

nuclear plane could circle the d for days without landing or re- ing.

nless it were denied air space over tern territories, it could show off capabilities to every nation.

ne Russians quietly forecast their ear plane two years ago.

* * *

terference with TV

RECENT report from the Post- Master General's Department listed complaints about interference with ption of TV in Australia during -7.

he main causes of interference prov- o be—

oor installation of aerials.

eceiver faults or improper adjust- t.

nduction from high tension lines.

it, in general, the interference prob- does not appear to be a serious This is largely because of the signal strength provided by the ons over a reasonable service area.

is noteworthy that, in the list of rferences quoted, not one is due to the operation of an amateur transmitter.

This point is well worth mentioning, for at one stage it was thought that amateurs might have their own troubles in this matter.

And there used to be a standing tendency, now happily not so prevalent, to blame the amateurs for any strange noises which might appear in a radio set

So far, they seem to have a pretty clean sheet, although they have their own active committees to co-operate with viewers in case of difficulties.

* * *

TV links in Australia

ACCORDING to the Postmaster-General (Mr Davidson), P.M.G. engineers are working on a research project to determine the most efficient and economical method of relaying TV programs throughout Australia.

The matter is becoming one of minor urgency, for quite soon work will commence on TV stations for other capital cities and centres in Australia. Without an adequate system of relays, TV stations will be greatly handicapped in their task of covering the Continent with spot news.

There are two main methods of carrying programs over long distances —co-axial cables and micro-wave links. The type of country through which communication must be made largely determines which method is the most economical and practical.

It is highly probable that a combination of both methods might be the best to use.

Radiation and flu

COSMIC radiation from outer spac may be the mysterious factor whic triggers off deadly world-wide epidemic like the recent Asian flu outbreak, according to the former deputy chief medical officer at the Health Ministry (Si Weldon Dalray) in London.

His theory aroused immediate scientific interest.

Sir Weldon said the influenza viru normally did little damage, but cosmi radiation caused a deadly new strai to appear in many different places a once.

The director of the World Influenza Centre (Dr C. H. Andrews) commented: "I think this may be an important discovery—the theory would certainly explain baffling world-wide outbreaks."

* * *

New light on strokes

THE average man who suffers a stroke can expect another within two years, according to Irving Wright, an American heart specialist.

Doctors are now concentrating studies on cerebral strokes.

Some strokes are the result of a cut-off in the supply of blood to the brain, starving some brain cells from lack of nourishment.

Other strokes come from the bursting of a blood vessel and drowning of part of the brain in blood.

Doctors now understand that strokes are not isolated accidents, causing brain damage, but, instead, a sign of generalised disease.

POPULAR SCIENCE QUIZ

Q: What is the method by which a space rocket obtains its power? How can it operate like a jet motor when there is no air in outer space for it to push against?

A: This is an old one which crops up so often that the answer cannot be repeated often enough. Unlike an aeroplane which uses a propeller or air-screw, a rocket does not need air to send it along. The word air-screw, which is the correct name for an aeroplane propellor, presupposes the presence of air through which the whirling blades can literally screw themselves, and it is the resulting air pressures which are set up that make the aircraft move. Without air, such a machine could not move along, let alone fly in the air.

Jet aircraft use air pressure on the wings to keep them up, but the source of forward power comes from the principle that every action has an equal and opposite reaction, to state it in simple terms. The thrust of hot gases out of the jet engine proceeds with great force, and it is the reaction to this force which produces the thrust. In air, there is an added advantage for such engines in that it can be used to mix with the fuel, entering at the front of the engine and of course emerging at the rear. But as far as efficiency goes, the air is a nuisance, for it absorbs considerable power as the machine is forced through it. In outer space, there is no air to help combustion, so that a rocket must carry all its own fuel. But there is no air to impede progress, and little if any gravity either, so that virtually all the reaction forces from the motor are available to send it along.

Q: What makes the noise when a whip cracks? Surely a piece of frayed string isn't strong enough to do this?

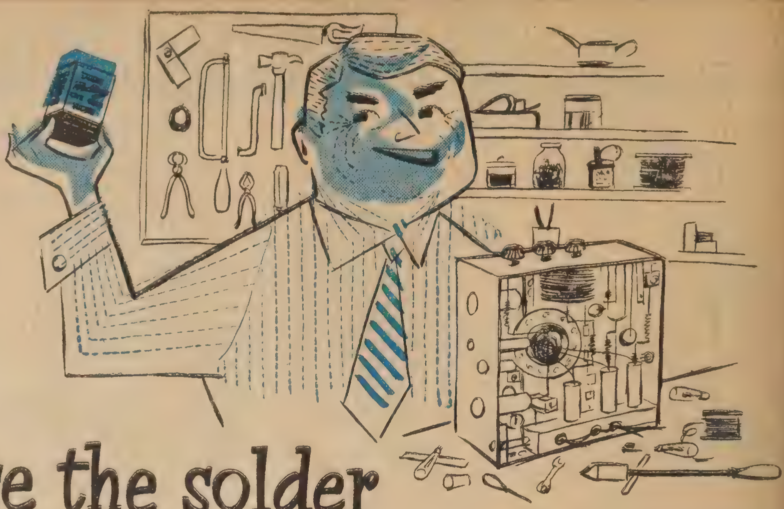
A: That's a point which has puzzled men for ages, particularly as some people seem to be able to crack whips more easily than others. Moreover loud cracks can be produced by comparatively little expended energy by some, while others flail the air to little avail.

Scientists have now discovered that the crack is caused by the tip of the whip moving so quickly that it literally breaks the sound barrier and produces a miniature version of the bang which occurs when an aircraft does the same thing. The aircraft bang is low pitched because as a rule it occurs some distance away, and like a thunderclap, loses most of its high frequency sounds travelling toward us.

But we are close to the wielder of the whip, and so we hear the sound as a sharp crack. It is estimated that, properly wielded, a whiplash, mainly in its sudden reversal of direction, can reach a velocity of 1000 miles per hour.

Q: Why doesn't the sun burn us up?

A: Because the earth's atmosphere absorbs enough of the harmful rays to prevent it. We must remember that we live in this atmosphere because our life has evolved to suit its conditions and these include the amount of radiation of all kinds received from the sun. We can, however, conceive of life forms which could perish very rapidly. Imagine, for instance, a skin structure so sensitive that it would burn in the presence of any ultra-violet. It would only be an extreme and opposite example of a skin which some people appear to possess, which makes them apparently immune from sunburn.



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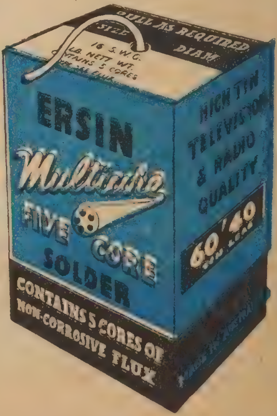
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.C. try TV on UHF

Monday, May 5, the BBC com-
nenced a second series of high-
experimental television transmis-
on UHF in Band V (610 Mc/s -
Mc/s) from the Crystal Palace.
urpose of these experimental trans-
ons, as in the first series, is to test
uitability of this band of fre-
ies for television broadcasting.

first series of tests, which ran from
nber 1957 to the end of March
used the normal British 405-line
ion standards, the same program-
eing transmitted in Band V as in
I so as to provide a direct com-
n.

second series of tests, which will
ue for three months, will use the
rn European standard of 625-
and the results will be compared
those obtained in the recent 405-
ests. It is hoped that these further
vill throw some light on the prob-
which would be encountered if it
decided to use the 625-line stan-
for a television service in Bands
nd V. There is no intention of
g any change in the 405-line stan-
used by the BBC in Band I.

UENCIES

experimental transmissions will
equencies of 654.25 Mc/s (vision)
59.75 Mc/s (sound). As in the first
the transmissions will be in black
hite only.

test transmissions have been plan-
y the BBC in co-operation with
elevision Advisory Committee and
adio Industry. A number of ex-
ental receivers will be used and the
the Post Office, the D.S.I.R., the
, and the Radio Industry will make
nprehensive study of the received
es.

* * *

tain's new defence

AIN has re-affirmed her intention
rely upon nuclear rockets for
e.

Government has been strongly
ed for not proceeding with man-
rcraft of phenomenal performance.
se include fighters much more ad-
than the supersonic P1 fighters
ay, and bombers with a perform-
ar exceeding that of the Victoria
ulcan jets.

y of these are in a stage of ad-
development, but no date has
nentioned by which they will have
etely taken over the country's air
e.

bridge the gap between the present
he rocket equipped future, pro-
n of the high rating aircraft now
vill be increased.

eventually they will disappear
the front line.

rockets in which Britain would
r faith are:

ballistic rocket launched from
round and more advanced than
ng of the same type being devel-
by the U.S.

ropeller bomb with nuclear war-
that can be fired 100 miles or
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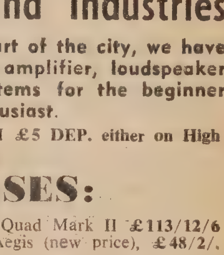

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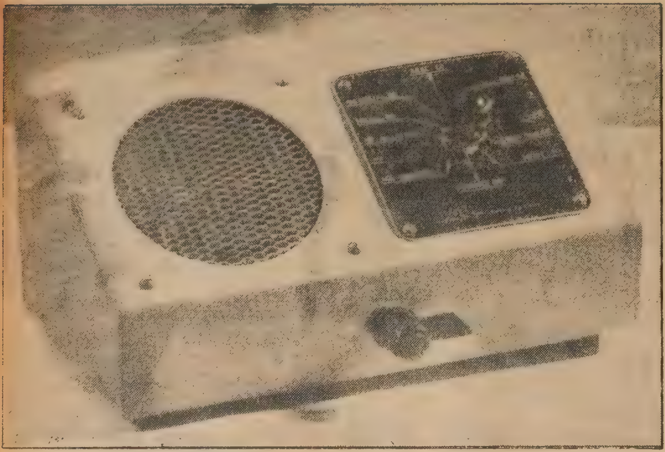


The neat sloping-panel metal case is in keeping with the new and highly efficient circuit used for the amplifier. Dimensions are: 8½in by 4½in by 4in deep overall.

A Transistorised Intercom. Unit

The greater availability of transistors now allows us to consider quite a few audio devices and an office intercom. system represents almost an ideal application. We have taker the opportunity to include the results of many experiments with various transistors anc transformers available at the present time.

by Maurice Findlay

THERE will be many readers who have joined us since the description of the previous intercom units or who have forgotten the original article and therefore we can profitably take a little space discussing the requirements of a suitable system again.

For example, the system should be capable of accommodating a reasonable number of units. In our case this is limited only by the number of positions available on a switch. A standard switch, readily available, permits 12 stations per system.

NO INTERFERENCE

Two-way conversation between any two stations in the system should be possible. The conversation between these two stations should not interfere with a conversation between any other two stations.

In order to satisfy this requirement a separate amplifier is required for each unit.

Complete secrecy is regarded as essential. No station should be able to listen in on a conversation directed toward another.

A press-to-talk system, together with a simple method of selecting the station to be called, is to be considered essential. In busy offices the very purpose of the intercom may be its advantage over the existing telephone in the matter of speed and convenience. Since you have only up to a dozen stations to choose from at the most the intercom selecting system should allow much quicker contact than a six-digit telephone number or even a four-digit house phone system.

It is considered that battery operation is to be preferred to power mains operation. A mains-operated system must be left with all units always in operation, otherwise a called station may not be able to reply immediately. Neither the battery amplifier previously described nor the transistor amplifier here have appreciable warm-up time.

The switching system can be arran so that power is being used only wh the system is actually in use. The c rent drain of the transistor amplifiers so small that even with greater th normal use the battery will last virtua as long as if it were standing on a sh unconnected. Because there are no f ments left running the cost of po from the batteries will actually be than for a mains-operated system.

It would be possible to operate transistor amplifiers from the ma given a suitable rectifier, but batte are so cheap compared with the cost the power supply that it just isn't a p position.

HOW IT WORKS

Before going on to discuss the de of the amplifier and the cabinet wi in detail a general picture of how system works will be of interest. can regard it as a block diagram words if you wish.

Each unit contains a speaker, amplifier and two switching systems. number of wires run between the u Actually there is one wire for each in the system plus an individual re (or earth) wire. Yet another wire di butes power for the amplifiers to e unit from a central source. This is venient, since only the one batter then required to power all units.

If for example there is a total of units in the system the interconnec wiring will be required to have a t of six conductors, plus the earth re system, about which we will have m to say later.

The essential point to understan that each of the lines which circu throughout the entire system is the ceiving line for one of the units. W each unit is in the receive, or no position the speaker is connected dir between this line and earth.

However, when a station is use to "talk out," the speaker is switche to behave as a microphone, with its o fed into the input of the amplifier. output of the amplifier is fed to o the lines as selected by the switch.

PROCEDURE

For the sake of an example let u say that the general manager on stati wishes to contact the sales manag station 5. For a start the speake both intercomm units 2 and 5 will been connected by a link inside respective units, across lines 2 a respectively.

The general manager turns his tor switch to position 5. He then p his "press-to-talk" switch, when functions occur simultaneously. speaker is switched to the input of fier No. 2, the output of the same fier is connected, through the se switch, across line No. 5 and pov applied to the amplifier. The chain microphone through the amplifier

d speaker is then complete and
eral manager can have his say.
n the sales manager replies the
is reversed. The speaker in unit
ow behaves as a microphone, the
r in the same unit is energised
speaker in unit No. 2 receives
ut through No. 2 line.

one possible catch here is that
eral manager will have to iden-
nself before speaking out, other-
o. 5 will not know where to turn
ctor switch. The chances are in
circumstances that No. 5 will
se No. 2 by his voice. ("That old
so again.") Of course the G.M.
be speaking from another office,
it would be necessary to say
ng from No. 4," or something
identify his position.

LING TWO CALLERS

her possibility with this system is
o stations will call a third station
one time. In this case the voices
callers will be heard and the
tation will have to switch to one
him to wait a moment, depend-
which is the more urgent.

ou will have already seen, the
ls of the system are not difficult
. It has been installed in a num-
offices with which we have had
l contact and proved to be a
mesaver. The one facility that it
hich could be of use in some
the ability to call a number of
simultaneously in order to allow
nces. This would require that
put of a particular amplifier be
ed across a number of lines at the
me.

couldn't simply connect all the
gether at the transmitting station
sing keys or some similar arrange-
otherwise the secrecy feature
disappear. A possible solution
be to install a switching system
connected the lines together at
nsmitting station only when the
o-talk" button is down. Such a
requires quite complicated and
switches. While it has been used
e commercial systems it adds
to the cost and bulk of the units.
e matter is so important as to
a round-table conference it is
worth the time for all members
o the one office.

IMPEDANCE

next important general matter to
p for discussion is the impedance
h the lines should work. For a
is obvious that it must be a
ow impedance because the capa-
between adjacent wires in a long
sely packed cable can be appre-
and it is necessary that the capa-
eactance between the wires at the
frequency involved be high com-
with the line impedance, if cross-
tween units is to be avoided.

nsive experiments in our own case
roved that it is quite practical to
the voice coil impedance of the
s, which may be 3.5 ohms, two
r something of that order. There
some losses with longer runs,
power output of the amplifiers
general efficiency of the system
cient to take care of all but ex-
situations.

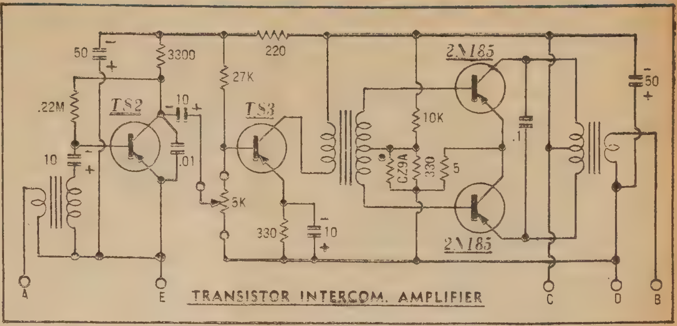
is essential for one station to be
way from the others you can always use heavier than normal intercom cable, or parallel conductors, choosing the wire gauge so that the total resistance of any pair is not more than twice the nominal voice coil impedance. If, in a large system, a remote station would require to speak to only, say, two other stations in the system it would be possible to economise on wiring by extending only the leads actually required.

In commenting on the system described previously, readers have suggested that it would be a good idea to work at about 600 ohms in the case of long runs. This would certainly reduce the losses to a negligible level in any practical system but could lead to problems of cross-talk between stations due to capacitive coupling.

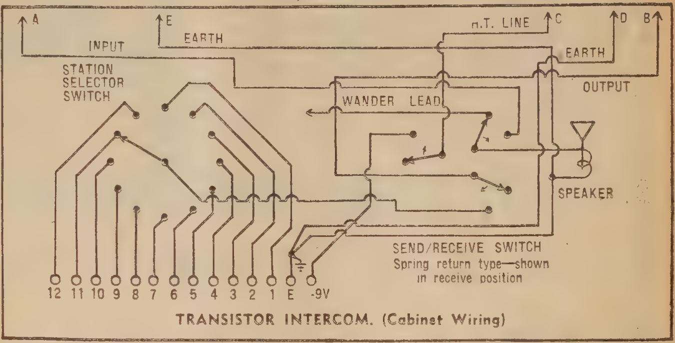
We have not conducted any experiments to determine just how serious the problem is or even if it actually exists at this impedance, since we are quite satisfied that the results are satisfactory at voice coil impedance.

Next, still talking in general terms, we come to the amplifier itself. In the 10 years since we first described an intercom, transistors have been invented, developed to extremely useful devices and made available on the commercial market. We are assured by the manu-

AMPLIFIER & CABINET CIRCUITS



TRANSISTOR INTERCOM. AMPLIFIER



TRANSISTOR INTERCOM. (Cabinet Wiring)

The circuit of the amplifier, which is built on a bakelite strip, appears at the top while the wiring inside the case is shown below. We suggest that you build the two parts separately according to the circuits and connect them together when both are finished.

PARTS LIST

(Parts for interconnection of units not included.)

1 special intercom. cabinet
2 trailer knobs
1 single pole, 12 position switch
1 three pole, 2 position, spring-return non-shorting switch
1 4 inch speaker
1 bakelite strip, 2 3/8in by 8 1/4in
2 8-lug tag strips
2 2N185 transistors
1 TS2 transistor
1 TS3 transistor
1 CZ9A thermistor
2 special transistor output transformers
1 special transistor driver transformer see article

CAPACITORS

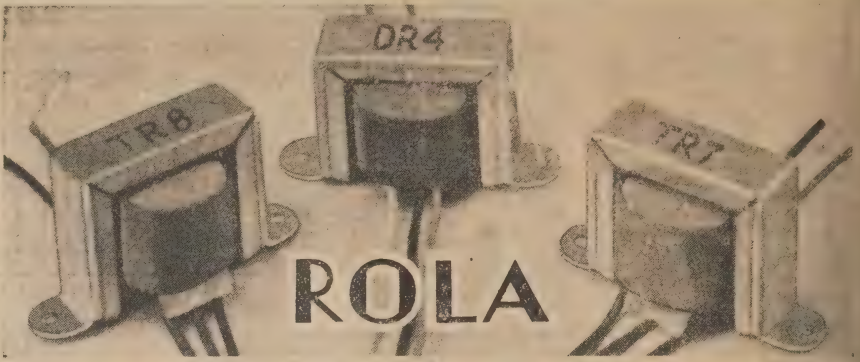
2 50uF 12 volt electrolytic, 3 10 uF 12 volt electrolytic, 1 0.1 uF 100 volt paper, 1 0.01 uF 100 volt paper or ceramic.

RESISTORS all 1/2 watt.

1 0.1 meg, 1 15,000 ohm, 1 10,000 ohm, 1 5,000 ohm potentiometer, 1 4,700 ohm, 2 330 ohms, 1 220 ohms, 1 4.7 or 5 ohms.

SUNDRIES

Hook-up wire, spaghetti tubing, rubber grommet, nuts and bolts eyelets for bakelite panel &c.



TRANSISTOR TRANSFORMERS

Suitable for use in the "Radio, Television and Hobbies"

"TRANSISTORISED INTERCOM AMPLIFIER"

These transformers have been designed in the Rola Laboratories specially to meet the requirements of Australian radio set manufacturers for highly efficient driver and output units which provide a good frequency response when used with standard type low-powered transistors.

They are intended to operate into a standard 3.5 ohm impedance loudspeaker voice coil. General specifications of the output types TR7 and TR8 are similar, but a greater signal input is required to get the increased power for which type TR8 is rated.

ROLA TRANSISTOR TRANSFORMER SPECIFICATIONS

TYPE	DESCRIPTION	IMPEDANCE OHMS	OUTPUT POWER 6 v.	OUTPUT POWER 9 v.
DR4	**Driver transformer**	**3,000 - 1,300 c.t.**		
TR7	**Output transformer**	**420 c.t. - 3.5**	**150 mW**	**250 mW**
TR8	**Output transformer**	**300 c.t. - 3.5**	**200 mW**	**375 mW**

HIGH EFFICIENCY LOUDSPEAKERS

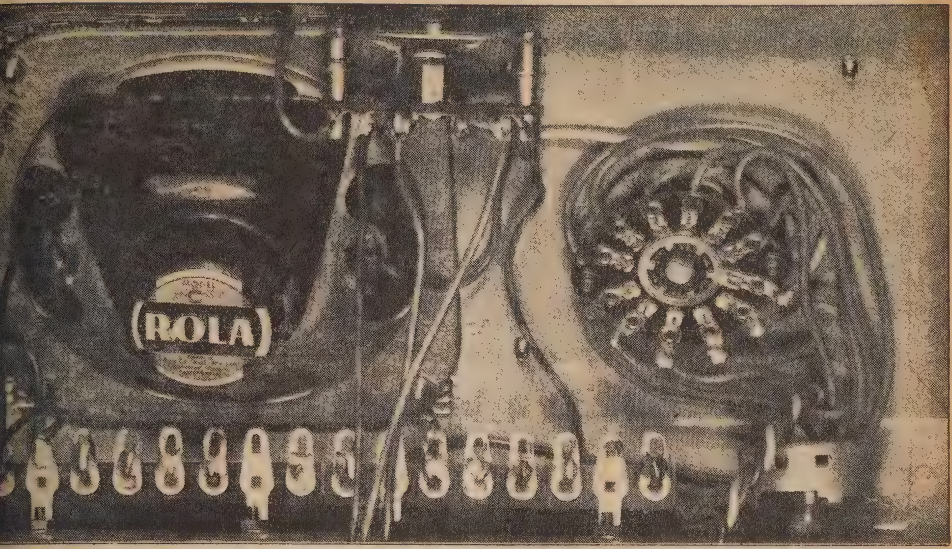
Two small high efficiency Rola loudspeakers intended for transistor or conventional battery-operated receivers have also been developed.

The first of these is the new Model 4C-05A fitted with an F44 diaphragm. This speaker is small in size — it measures only 4⅛" overall by 1¾" deep, light in weight — only 6¾ oz. (without transformer), yet has an efficiency equal to that of the earlier Model 4F. Its low cost, small dimensions and light weight make the 4C-O5A an ideal choice for miniaturised battery or transistor receivers.

Where even higher efficiency is required and space and weight are not critical, it i recommended that the Model 5F be used.

ROLA COMPANY (AUST.) PTY. LTD.

EW INSIDE CABINET SHOWS MAJOR COMPONENTS



mponents mounted inside the metal cabinet are visible in this photograph. The press-to-talk switch is at the top, the speaker left with the station selector switch alongside to the right. Tag strips connecting with outgoing lines are at the lower left with the volume control pot at the bottom right.

of the types specified that sup- e sufficient to meet any likely

stors are a "natural" for a pro- his nature. They are compact, y economical of power and, their quite liberal temperature are not exceeded, extremely In fact, there seems no reason ose that a transistor will ever t if it is not abused, and it can red into circuit in the same way istor or a capacitor.

power output of the amplifier d here is greater than that of the valve amplifier, while the aver- er consumed is less than for the alone of the valve amplifier.

MICROPHONIC

stors are non-microphonic, per- very high gains to be achieved undesirable effects. They do om noise, but phenomenal gain an be achieved before this be- troublesome, provided suitable g conditions are chosen.

ompact nature of the transistors us to produce an entirely new ller cabinet for the units. It is l and therefore there is little pace due to its thickness. A panel brings the station selector nd the speaker at the best angle operator when placed on a desk length.

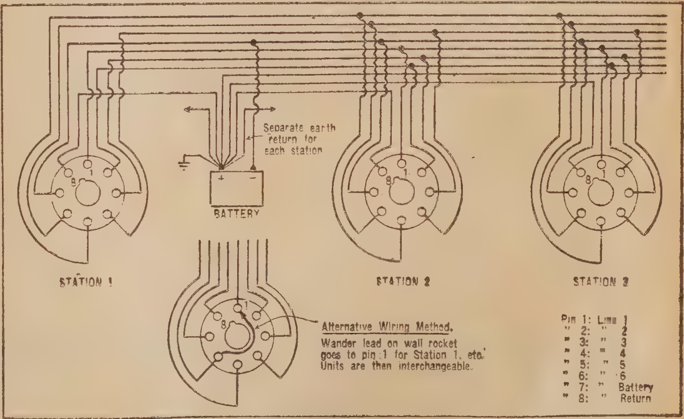
anically, transistors are so l that there is little point in the onal chassis form of construc- Ve have found that a far more base for the amplifier is a strip bakelite (sav about 1-16th inch) elets in suitable places for tag Both the eyelets and the punch- lite are available commercially if .

The speaker, the switches and terminating strips can conveniently be mounted directly on the metal cabinet, while a suitable place for the amplifier is the baseplate of the cabinet. Input and output impedances are so low that flexible leads between the amplifier and cabinet wiring can be run without any special precautions such as separation or shielding. In fact no shielded wires are required anywhere in the system, since the impedance levels in the amplifier itself are very much lower than in a valve amplifier.

A considerable amount of thought was given to the choice of selector, and especially the press-to-talk switch. While commercial units can use all sorts of elaborate switches (at appropriate cost) we are limited to components which are available through the usual radio supply firms and thence to readers.

The single-pole 12-position switch used for station selection is relatively straightforward and few readers will have cause to complain about the appearance or efficiency of this general idea.

. For the press-to-talk switch we felt that a lever looking somewhat like a


Separate earth return for each station
+
−
BATTERY
1
8
STATION 1
STATION 2
STATION 3
Alternative Wiring Method.
Wander lead on wall rocket goes to pin 1 for Station 1, etc. Units are then interchangeable.
Pin 1: Line 1
" 2: " 2
" 3: " 3
" 4: " 4
" 5: " 5
" 6: " 6
" 7: " Battery
" 8: " Return

A typical interconnection diagram for the intercom. units. The important point is that the earth return wires for each unit return separately to a common point, preferably at the battery. Failure to adopt this procedure will result in cross talk when more than one conversation is in progress at the one time.

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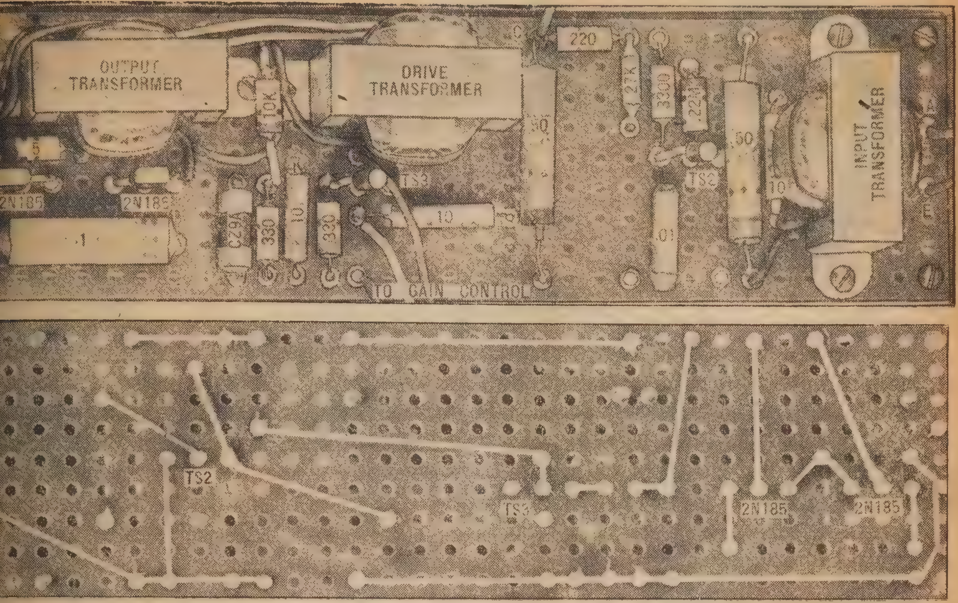
WIRING DETAILS OF THE TRANSISTOR AMPLIFIER



nplifier is constructed on a bakelite strip 8¼in by 2⅜in. Solder joints are made to eyelets secured in holes in the bakelite. nsistors are soldered directly into circuit along with resistors, capacitors, &c. Transistor leads should be left 1in. long. It is desirable to use long-nosed pliers as a heat sink when soldering.

er space bar attached to the the cabinet would fit in well appearance and be functional. , we would then have had to a special switch or persuade a turer to do so. The former ave discouraged readers without workshops and unlimited time, e latter would have resulted in costly item. We therefore de- compromise and use a spring- rotary switch together with a nob as in the earlier intercom. e switches and the knobs will have to be ordered, but apart few days wait there should be ulty about supplies.

FIER DESIGN

bly the most interesting feature ew intercom. unit is the transis- lifier. Very little knowledge of rs is needed to construct the am- nd provided you assemble all cified components according to it and photographs, there is no why each of your amplifiers not work just as well as the

e other hand, most of our readers now something of the design of nt either so that they can sub- ear equivalent parts or just for of general interest.

inary experiments indicated hree-stage amplifier was required de enough gain to build up the f the four-inch speaker, used as phone, to the point where it applied to another speaker at le level. Actually, the final cir- s have some reserve of gain to variations in speaker efficiency, transistors, voice levels and other factors.

A detailed consideration of the design of the amplifier can best start with the output stage. The collector dissipation rating of the largest of the readily available transistors is relatively low and it is necessary to operate the output stage in class B push-pull in order to obtain a reasonably high power output.

Having settled for class B it almost automatically follows that the driver stage be transformer coupled to the output stage. Circuits not involving a transformer are available but carry with them greater disadvantages than the cost and bulk of the transformer, in this case at least.

A big advantage of class B is that the current drain of the stage is largely proportional to the signal level: with no signal, the current drain is very low while with maximum signal it is maximum. Power is consumed only when the amplifier is actually delivering output. This makes for very high overall efficiency.

In the case of the transistor class B output stage the bias deserves special consideration because the distortion and the ability of the amplifier to operate in a stable manner at high temperatures are intimately connected with the bias circuits chosen.

Normal practice in class B amplifiers is to bias the output device, be it valve or transistor, to the point of "virtual cut-off." This is the point at which the output characteristic would intersect the zero current line if it were perfectly linear.

If the transistor is biased so that the standing current is less than optimum, excessive "crossover distortion" will occur while, if the bias be adjusted so that the standing collector current is greater than optimum, power will be wasted needlessly.

Perhaps even more significant in the case of transistor amplifiers is the increased collector dissipation which accompanies excessive standing current. Heat dissipated at the collector causes its temperature to rise above the ambient temperature. The transistor is sensitive to temperature and the standing collector current increases as the temperature increases.

If conditions are not very carefully controlled it is possible for a "run-away" condition to occur in which the increased collector current causes an increase in temperature which causes a further increase in collector current until finally the transistor destroys itself.

THERMAL INSTABILITY

Transistor circuit design is, in general, more involved than valve circuit design and one of the reasons of this is that some means of rending the operating point of the transistor reasonably stable over a wide range of temperature has to be included.

In most cases this can take the form of a network of normal resistors but there are times when a thermally sensitive resistive element can be included to give even better stability over a given temperature range.

All stages of the new intercomm. amplifier include some form of thermal stabilisation, the circuit details depending on the needs of the particular stage.

The base, collector and emitter of a

COLLARO

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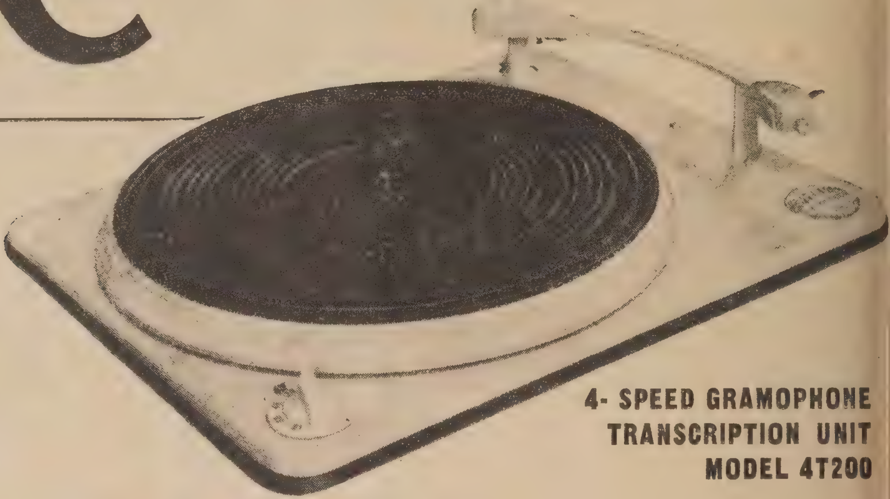

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r are roughly equivalent to the
te and cathode respectively of
valve. However, there are
t differences and the main value
analogy is as a stepping stone
valves and transistors.

nost important characteristic in
of a valve is the relation be-
late current and grid voltage.
edance looking into grid cir-
ormally linear and very high,
wing for the grid return resistor
ust necessarily be included.

e transistor the analogous re-
that between the collector cur-
the base current. For a linear
urrent a linear drive current
supplied. However, the input
of a transistor amplifier look-
een the base and emitter is not
, furthermore, it is not even

EQUIREMENTS

rmore, the bias which estab-
operating point for the transis-
ld be essentially a current rather
age bias. While the resistors in
al common emitter arrangement
ilar to those in a valve ampli-
cathode bias, closer examination
lues will show that the similarity
ight.

r difference between transistors
es is that valves with zero vol-
, in most cases, draw a high
Transistors with zero current
a low collector current. In
some bias current must be ap-
order to bring the transistor to
red operating point.

lass A amplifiers the bias is
bring the transistor somewhere
centre of its characteristic while
B amplifiers the bias is usually
that there is a small standing
current.

circuit, the forward bias for
5's in the output stage is de-
by a network of four resistors
ged that the standing current
signal tends to remain reason-
stant with changes in tempera-
e natural stability of the cir-
isted by the inclusion of a ther-
sitive resistor with a negative
of temperature.

ATURE COMPENSATION

temperature increases the ef-
sistance between the terminals
0 ohm resistor and the CZ9A
r in parallel decreases, reducing
rd current bias and hence tend-
set the natural increase in stand-
tor current with increasing tem-

lues we have chosen are what
to be the best compromise. If
that you could tolerate a little
ortion, the 10,000 ohm resistor
the negative high tension line
r transformer centre tap could
ed in 15,000 ohms with the ad-
hat the standing collector cur-
th output transistors will be re-
In consistently warm climates
0 ohms would probably be the
e.

C load into which the output
operate is worthy of some
. A number of transformers
istors with differing primary
es are available and readers will
know what is the optimum.

values tend to increase the
tput, the transistor dissipation and the drive requirements. While we would like to have as much power output as possible, it is essential that the transistors be operated in a safe condition. We would suggest that the minimum load be 300 ohms collector to collector when the power delivered to the output line will be 300 milliwatts or a little more.

With higher loads, the maximum power output decreases and if it is desired that the output be of the order of 200 mw we would suggest that you choose a transformer reflecting a load no higher than about 450 ohms. A good all round optimum is the 375 ohms collector to collector which has been used by the manufacturers of the transistors in a suggested circuit.

The above assumes that the secondary is feeding into exactly its rated impedance which is usually near enough to being the case when a portable receiver or record player is involved. However, the resistance of the line connecting the output of the intercomm. amplifier to the speaker may easily be comparable with the voice coil impedance. The actual load reflected to the transistors may then be greater than the stated transformer primary impedance.

For example, if the speaker is connected to the amplifier through 100 feet of thin bell wire the additonal resistance introduced into circuit is about 3 ohms. Therefore, over most of the frequency range, the collector to collector impedance presented to the transistors will be almost twice the marked value, assuming a 3.5 ohm voice coil.

OUTPUT TRANSFORMER

Therefore, in cases where none of the lines between units is to be very short you could well choose the lowest of the primary impedance transformers mentioned, that is, 300 ohms.

We have already made the point that the dissipation ratings of the transistors can be exceeded if the load resistance is too low. At very low frequencies the inductive reactance of the transformer primary becomes low and at very high frequencies the reactance of the capacitor across the primary winding becomes low. (The capacitor is included to minimise crossover distortion and give a tone control effect.) Therefore, if the output transistors are driven hard at either very high or very low frequencies they could be damaged.

Trouble is only likely to occur if you attempt to measure the frequency response at near maximum output. Speech fed through the amplifier in the normal way has few sustained very high or very low notes.

Always be careful not to feed the amplifier into a shorted line.

The driver stage uses a single TS3 transistor with a resistive stabilising and bias network generally similar to that of the output stage except that the values are chosen for class A operation. Also, the stage is designed so that it has a reserve of output at any likely temperature without resorting to thermistors.

DRIVER BIAS

The forward bias current is obtained through a resistor which connects with the decoupled negative high-tension line. The connection shown has the advantage that a definite time elapses between the application of the high tension and the flow of collector current in the transistor with a consequent reduction in switching surges.

The transformer used to couple the collector of the driver transistor to the bases of the output transistors is worthy of some comment. The turns ratio of this transformer, together with the operating conditions of the driver transformer, must be chosen so that adequate drive is applied to output transistors. Furthermore, this drive must result in linear output from the output transistors with the driver current drain as small as possible consistent with other requirements.

A number of driver transformers are available with ratios varying from 1 to 1 primary to full secondary to about 2½ to 1 primary to full secondary. All will work satisfactorily, but it is interesting to note the factors limiting the performance at the extremes of the range.

In the case of a transformer with a low primary impedance the current drain of the driver stage must be high in order to develop sufficient power to drive the output stage fully. If taken to the extreme, this can lead to either or both the transistor's current and dissipation ratings being exceeded.

Going to the other extreme, if the primary of the driver transformer has a very high impedance, the collector of the driver transistor will not be able to swing over a sufficiently wide range to drive the output transistors to full output. This is because the peak-to-peak voltage at the primary of the transformer is limited to twice the supply voltage of the driver transistor (or a little less).

(Note that any voltage developed across an emitter resistor in the driver stage must be subtracted from the total supply in calculating the actual supply voltage for the transistor.)

Further, there is the question of distortion. There are a number of factors contributing to the total distortion in the output stage, one of which we have already discussed. Two other factors are the non-linearity of the input characteristic and the reduction in the current gain at high collector currents.

DRIVE REQUIREMENTS

If the current gain characteristic were linear it would be desirable to feed the bases of the output transistors from a high impedance, or constant current, source. However, it often happens that the non-linearities in the input and output characteristic tend to cancel giving less distortion with well-regulated drive.

It is difficult to obtain good driver regulation together with economy. Therefore practical operating conditions are not always chosen for minimum distortion.

A 10 uF electrolytic capacitor is connected across the emitter resistor of the driver transistor to prevent degeneration.

The value is chosen so that there is actually some degeneration of the lower frequencies within the range. This is desirable both to balance the characteristics of the speaker used as a microphone and to prevent too much low frequency drive being fed into the output transistors.

If you find that, with the particular combination of voices and speakers you have, there is a reserve of gain, you could try reducing the value of this capacitor down to about 0.5 uF. This will reduce the tendency to "woofiness" exhibited by the small speakers used as microphones and also make the best use

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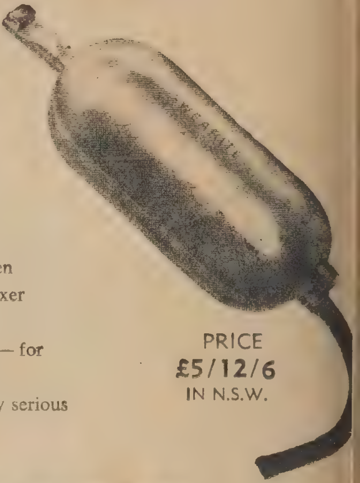

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output of the power transistors. ather simpler stabilising circuit is or the first amplifier stage. For- ias is obtained from the collector transistor through a simple drop- esistor. When the collector cur- creases due to rising temperature, tage drops and so does the for- ias current.

MAL STABILITY

circuit does not control the col- current of the stage to within the mits as the previous network but er shift in operating point is per- since the stage is handling very gnal levels.

vell as the D.C. feedback, a small of A.C. negative feedback oc- ith this circuit. The amount de- on the internal impedance of the feeding the base of transistor. In se it can be neglected since the source impedance is low. The e feedback could be eliminated ns of a network requiring an addi- resistor and capacitor but this not be worthwhile. The reason for he circuit is to save two resistors electrolytic capacitor.

transistor used in the input stage either a TS1 or a TS2 with a nce for the TS2 since it will give gain. Types TS1, TS2 or TS3 e used in the driver stage, but 3 is to be preferred again because higher gain.

apacitor between collector and of the input transistor helps to at- the extreme high frequencies and ensure stability under certain con-

NG DETAILS

low impedances of transistors cir- pose some problems with regard mmon impedances in return cir- articularly in high-gain amplifiers.

his case it is necessary to run a e wire from the return circuit of out transistor back to the speaker oil in order to ensure that poten- uilt up across any lead common input and output circuits do not in feedback and possibly instabi- f you carry out the wiring exactly wn in the circuit diagram there no need for worry on this score.

have suggested in the circuit that nsformer be used between the r/microphone and the input of the or. This transformer may be of ne type as used to couple the out- ansistors to the line. The exact nce ratio is not critical.

, in fact, quite in order to use a speaker transformer with a ratio , 3.5 ohms to 7,000 ohms and will be very little difference in al results.

hermore, it is possible to feed the voice coil directly into the base of the input transistor completely ting the transformer. The gain op appreciably but there will be when it is important to save on d the gain without the transformer sufficient.

ISFORMER PLACEMENT

the layout shown there is no iable magnetic coupling between out and output transformers, but ld be undesirable to have them ed closer than about three or four

those who like to experiment, it is possible to apply negative feedback over the last two stages of the amplifier. With negative feedback it will be possible to reduce slightly the standing current of the output transistors.

Place a 10 ohm resistor between the 330 ohm and 10 uF capacitor in the emitter circuit of the TS3 driver and the return line. From the junction of the 330 ohm, 10 ohm and 10 uF components connect a 100 ohm resistor back to the active side of the voice coil winding.

If this connection causes the gain to increase or the amplifier to oscillate it will be necessary to reverse the connections to either the primary or the secondary winding.

With the values mentioned and average transistors, the feedback will be of the order of 6 db but it can be increased or decreased by decreasing or increasing the value, respectively, of the feedback resistor (100 ohms). Extremely low values will not only result in excessive loss of gain but may result in spurious oscillation.

So much for the amplifier.

CABINET WIRING

The wiring inside the cabinet is straightforward except for the point about the earth return for the preamplifier. The point is made clear by the circuit diagram and there is no possibility of error provided you follow it exactly. The object of the extra return wire is to ensure that none of the wiring connecting the speaker (used as a microphone) to the input of the amplifier is common to the output circuit.

Whether the phasing of the transformers happens to be such as to give positive or negative feedback, oscillation will almost certainly occur and could be damaging to the output transistors if permitted to continue.

Because of their relatively low impedances, transistors are particularly prone to feedback troubles due to common impedances. However, in this case the trouble is mainly due to the low impedance of the input and output circuits rather than the transistors themselves. The original valve intercom. amplifier had to be wired in a similar manner for the same reason.

If the low impedance is a disadvantage in one way it is an advantage in another because no shielding is required in the cabinet wiring. Circuits connected with both the input and output of the amplifier can connect to the same switch without the troubles with instabiilty which would occur in the case of high impedance valve circuits. Just to prove the point, we bound the input and output wires leading from the amplifier to the cabinet together in a cable without any instability troubles.

INSTALLATION

The interconnecting wiring which we have already mentioned briefly is deserving of some special mention. Further, we have prepared a special diagram to clarify some of the more important points.

The most important point to note is that each station in the system should have a separate earth return and that this return should be made to the positive terminal of the battery. If desired a connection can be made between the positive terminal of the battery and an external earth such as a water pipe. This will not be strictly necessary.

When we speak of a separate earth return for each station we mean that the earth wires must be insulated from each other right up to the common point. The reason is that all connecting wires in the system will have some audio voltage developed across them due to their resistance. If a length of wire happens to be common to two pairs of stations in the system "cross talk" will occur. Apart from the nuisance of the background noises, the secrecy feature of the system disappears.

PRECAUTIONS

The volume of the cross talk depends on the resistance of the common wire and can be quite low. However, when installing a complete system it is little trouble to include the extra conductors.

From the service point of view, there is an advantage in having all units identical. A spare unit can then be kept and should a unit fail in service, it is simply a matter of substituting the spare. The faulty unit can then be repaired at leisure.

In the normal way, the receiving line is selected by a wander lead inside the unit. However, if the wander lead is extended through the flexible cable to the plug, say via pin 6, the receiving line can be selected inside the wall socket and the units interchanged without the need for changing a lead inside the case.

The disadvantage is that it is then only possible to accommodate five stations with an octal plug. If you must have six stations, connect the wander lead inside the instrument. On the other hand if you must have seven or more stations, you will need an extra, say a seven pin, plug anyway and you may as well make the wander lead connection inside the wall socket.

CONCLUSION

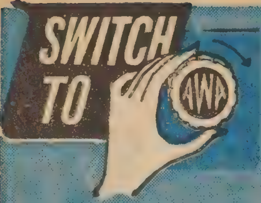
The cabinet design we have used for the original design is capable of variation to suit individual requirements since positions of components are not critical.

In conclusion, a few words about possible alternative amplifiers designs may be helpful.

There is the possibility of applying feedback over the last two stages, using a small value emitter bypass capacitor to shape the frequency response characteristic and omitting the input transformer. The first two make an appreciable improvement to the general quality of the audio while the omission of the input transformer permits the amplifier to be made smaller.

All three modifications result in a loss in effective amplification.

However, at slightly greater cost it would be possible to install an additional transistor amplifier stage which would more than make up the overall loss. Such a stage could be installed between the present preamplifier and driver and may use either a TS2 or a TS3. The emitter bias resistor could be about 1,500 ohms bypassed by a 100 uF, the collector load 4,700 ohms and the coupling capacitor to the next stage 10 uF. The gain control could be a 10,000 ohm pot between the base of the same transistor and ground while the forward bias resistor between the supply line and base should be about .047 meg. Both load and bias resistors should connect to the decoupled supply line. The present 5,000 ohm gain control will no longer be required and may be replaced with a fixed resistor.



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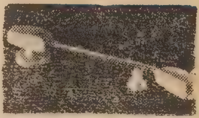

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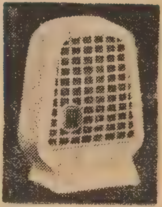

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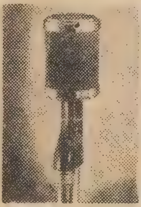

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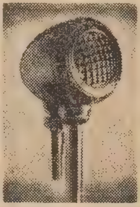

B110. Plastic torpedo form.

R474. Studio type, 4 cell, omnidirectional

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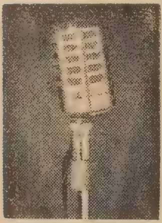
RFC and RFC5/L. Single cell semi-directional, high or low impedance



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1. Oscillogram of pickup output showing the full orchestra at the left, which is then followed by drums and cymbals.

All About Audio and Hi-Fi

By G. A. BRIGGS

SPEAKER POWER AND EFFICIENCY

PART 8

is article the writer discusses the factors that determine the power handling ability and efficiency of high fidelity loudspeakers.

have seen that a diffuser can be subdue peaks in the upper re- and reduce beaming effects. The n can also be tackled electronical- e speaker circuit by using a filter. viding network in multi-speaker is designed to limit the activi- each unit to its most satisfactory range and has become almost d practice in wide-response in- ns. It is obvious that similar s can be used on a single speaker two or more units working in , although the full effect of a network will not be obtained.

e is, however, the benefit of ness from units working in due to cancellation of reso- which rarely occur at identical cies in different speakers. The ow described was made up by E. Cooke, and could easily be ed at home by the average enter.

ves continuously variable attenu- p to 15 db centred around a of five frequencies, 2, 3, 4, 5, or selected by a switch. The "off" of the switch enables rapid mparisons with unmodified res- of the speaker (2) to be made altering the resistor setting.

filter consists of a parallel-tuned sonant circuit shunted by a resistor R. The tapped air- nductor L is wound by hand; the capacitor C may be any good ype obtainable from jobbers. R ire-wound, linear taper variable, is an ordinary 6-position switch. ll circuit is given in Fig. 2. filter is placed in series with the aker, and the switch gives maxi- ejection at various frequencies as —

POSITION	INDUCTANCE	CENTRE OF TROUGH
1	6.2 mhy.	2 kc.
2	2.8 mhy.	3 kc.
3	1.6 mhy.	4 kc.
4	1.0 mhy.	5 kc.
5	0.7 mhy.	6 kc.
6	Filter off	

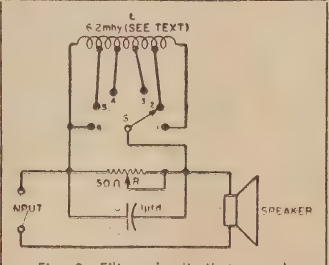
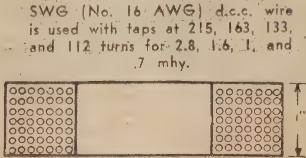


Fig. 2. Filter circuit that can be employed as tone control with speakers of 8-15 ohms impedance. (after E. M. Price.)

Fig. 3. Dimensions of the 6.2 mhy. tapped coil used in the filter circuit. 303 turns of No. 18 British SWG (No. 16 AWG) d.c.c. wire is used with taps at 215, 163, 133, and 112 turns for 2.8, 1.6, 1, and .7 mhy.



With R set at its full value of 50 ohms, the maximum dip in response of about 15 db for each switch position is produced. A general picture of results is given in Figs. 4 and 5.

The air-cored inductor L consists of 303 turns of No. 18 SWG (No. 16 AWG) double cotton-covered copper wire. Tappings are brought out as shown in Fig. 2. The total resistance is only 1.2 ohms so the insertion loss is negligible outside the region of resonance.

I have been using one of these filters with an experimental speaker system which has some annoyance value in the upper middle register. It works very well, but it is difficult to decide which is the "correct" setting and I would always prefer a speaker which did not require the treatment.

"PRESENCE" EFFECT

The general effect is similar to the use of a so-called "presence" control on amplifiers, which I find much more baffling than simply relying on the normal bass and treble controls, which usually prove to be adequate.

But there is one possible application of the filter which can be fully recommended, and that is where a wide range speaker is being used on a commercial set not equipped with adequate tone controls and with an over-all response shaped like a salmon, with all the best cuts in the middle.

A large speaker system often sounds woolly on music and resonant on speech with this type of input, and a touch of tone control in the speaker circuit often works wonders.

POWER HANDLING AND EFFICIENCY.

These qualities in a loudspeaker are so interdependent that we might as well deal with them together.

I always think that for domestic use the power handling capacity of a speaker is a very much over-rated virtue; we are concerned with how much comes out of a speaker, not with how much we can put into it.

The main difficulty is the absence of

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gnised system of rating, plus that the method of mounting sults.

ly the best assessment is to he speaker on full orchestra— cymbals—and also on organ t at peaks which are free from , harshness, and undue boomi-

rchestra is mentioned here ly because, with modern re- echniques, there is far more the upper register than there e. In fact, the hi-fi craze has duced too much top, but there me signs of a return to sanity. on at high frequencies is al- h more distressing to the ear w frequencies.

RATIVE OUTPUT

cillogram of Fig. 1 shows that produced by cymbals is almost the drums. The output from was photographed on the the left we have full orches- comparison with drums and hat follow. It is interesting to steep wavefront produced by cussion instruments; any over- f amplifier or speaker at these uld obviously mar results.

a loudspeaker at a single fre- s quite useless, because too pends on the choice of fre- nd the speaker does not have at a single frequency—it al- eives powerful harmonics.

s is not to say that **testing** a er at a single frequency is use-

of course, vital to any assess- performance.

e already stated that method ng affects results. If reflex or ing improves the waveform at encies for a given **output** of en frequency doubling and re reduced and so is inter- n; but the important point is t. No system can be judged the amount of input it will

one reason why the open till better at the bass end than le imagine, in spite of cut-off itation of size.

ne is free to move as it likes sound waves from back and r the room without restriction. aker will handle fewer watts x and enclosed cabinet types, ds **fewer watts for equivalent utput over most of the audio**

R EFFICIENCY

ity that it is almost impossible e total speaker output, but it asy to measure and calculate r Cooke uses a sliderule, but do it on my fingers.) This is abit of rating speakers on in- ignoring output has been so adopted.

not be too strongly empha- true efficiency in a moving- ker depends on flux density s the quality in a magnet that money. And in this connec- efer to total flux, which is the f gauss and gap dimensions width, and depth).

possible to assess the value of by a statement of gauss alone, lines per square centimetre

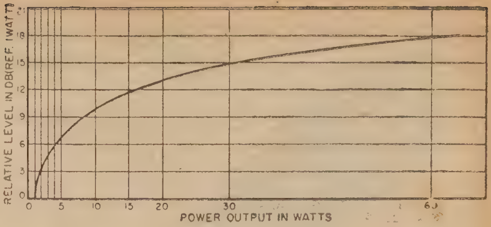

Fig. 4. Relationship between the power input to a loudspeaker and the amount of sound that it produces taking 1 watt as reference.

with a typical 1in centre pole would give 54,000 total flux, where 13,000 lines with a 1¾in centre pole would produce 145,000 lines, at an extra cost of about 100 per cent.

Magnet weight gives a rough idea of value, but as the prices of magnetic alloys vary, the weight is not a complete guide. Actually, it makes no difference to the user which type of magnet is employed; whether it is alni, alnico, alcomax, ticonal, ceramic, or hygienic does not matter. The only thing that counts in value is the total flux. All modern magnets merit the description **permanent.**

EFFICIENCY AND WATTS

It is always difficult to grasp the relationship between the power we put into a speaker and the amount of sound which comes out, because a twofold increase in power produces only 3 db increase in sound pressure, which is just easily perceptible. (To the ear, the increase sounds more like 33 per cent than 100 per cent.) Fig. 3 shows the relationship, taking 1 watt as a reference.

Acoustically, the increase in level caused by an increase in power from 30 to 60 watts is the same as from 1 to 2 watts, but electrically it is quite a different story. As Fig. 3 shows, it pays to use a high-efficiency (i.e., high flux density) loudspeaker and work on the steep portion of the curve below 15 watts, because the next 3 db are at a high premium in terms of amplifier watts, which cost money and involve bulky equipment.

DOUBLING THE POWER

We have ourselves often been astonished at the small increase in sound level in a concert hall which results from doubling the power. Using four 15-watt amplifiers, each 15 ohms output, in parallel, gives 60 watts when four 15-ohm speakers are switched on, also in parallel. With one speaker in circuit the available power is only 15 watts due to mismatch.

Under these conditions, two speakers are better than one and four are better than two, but the total difference never **sounds** like 45 watts. The same argument applies in reverse under domestic conditions, where we can drop from 30 watts to 15 watts in amplifier output with little apparent sacrifice in sound.

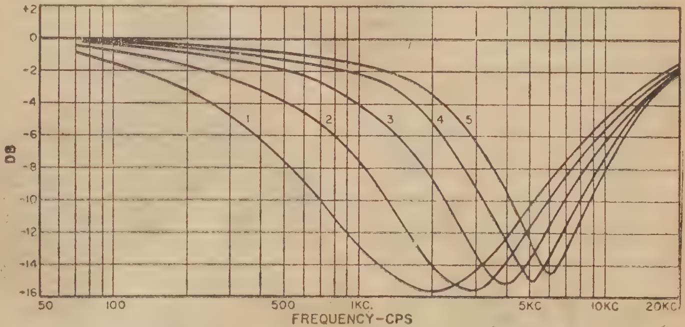

Fig. 5. Audio output response curves of the filter circuit described previously. Note that as more inductance is switched in the dip moves downward from 6 to 2 kc.

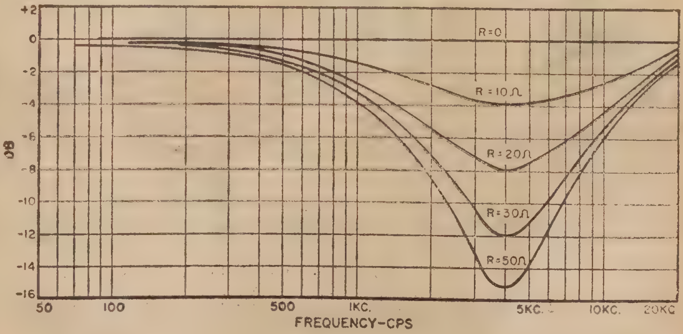

Fig. 6. These response curves show what happens to the attenuation as the resistor is varied and the coil tap remains on 3rd position. Maximum dip here is 15 db.

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der will notice I am careful to can drop . . ." rather than you, this viewpoint is more popular in the States.)

t that the margin of safety on s shown in Fig. 1 is greater 30-watt amplifier than with a r, but I am assuming that the levels of 3-5 watts on full or- previously stated as adequate ot touch 15 watts on transient ith drums and cymbals.

even more difficult than rating andling capacity. When I see that the efficiency of horn- peakers is 40 per cent compared per cent for reflex enclosures, as low as 2 per cent for small affles, I can only conclude that itions of test do not even ap- e the conditions of use, so the are of doubtful value to the listener.

UREMENT OF EFFICIENCY

uestion of where a test is made al importance. For instance, if k under free-field conditions sure the output at the mouth n you will obtain maximum but if an open baffle is used the in front of the cone represents f the output which would be in a live room. The reverbera- e of the listening room also esults—the longer it is, the he build up of sound, but this ot necessarily affect all speak- e same extent.

trongly directional properties loading are too well-known to ther emphasis, but if efficiency made on-axis they do not ap- ou listen 30 deg. off-axis. In rds, directional properties have do with the question, and an ctional speaker system rated as 8 per cent efficient might average sound level in a normal room almost equal to horn- ypes rated much higher.

of this series will deal with mounting and response curves v that these differences are not as one might expect, although r that the totally enclosed cab- l with sound absorbents mops he sound produced by the cone, ex enclosures absorb much of fe and upper registers.

FIER OUTPUT

elationship between speaker effi- nd amplifier watts is well sum- by N. H. Crowhurst as

a 2 per cent efficiency speaker arison with a 10 per cent effi- aker. Obviously, a 10-watt am- ith a 10 per cent efficient speak- produce the same acoustic out- the room as will a 50-watt with a 2 per cent efficient Both will give a maximum of att into the room."

owhurst also said that the actu- energy you need in the living only a matter of hundreds of s at the peak. I agree.

I think, necessary here to re- warning that we only get 10 t of a 10-watt amplifier when rectly loaded. Amplifier makers o the more fortunate members audio industry; they provide a

(Continued on Page 127)

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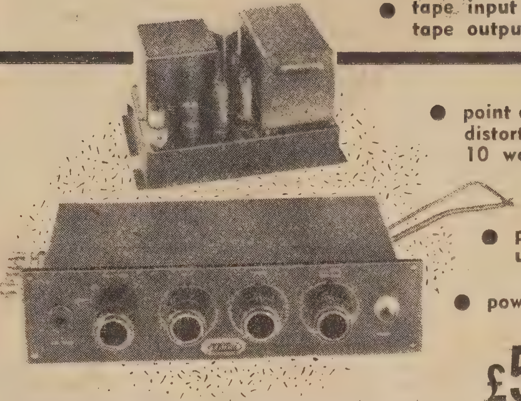

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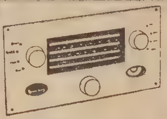

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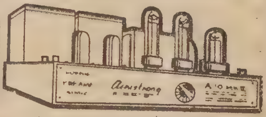

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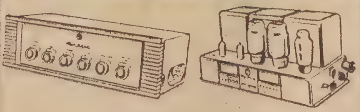

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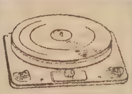

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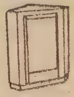

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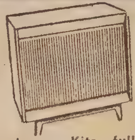

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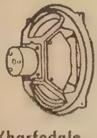

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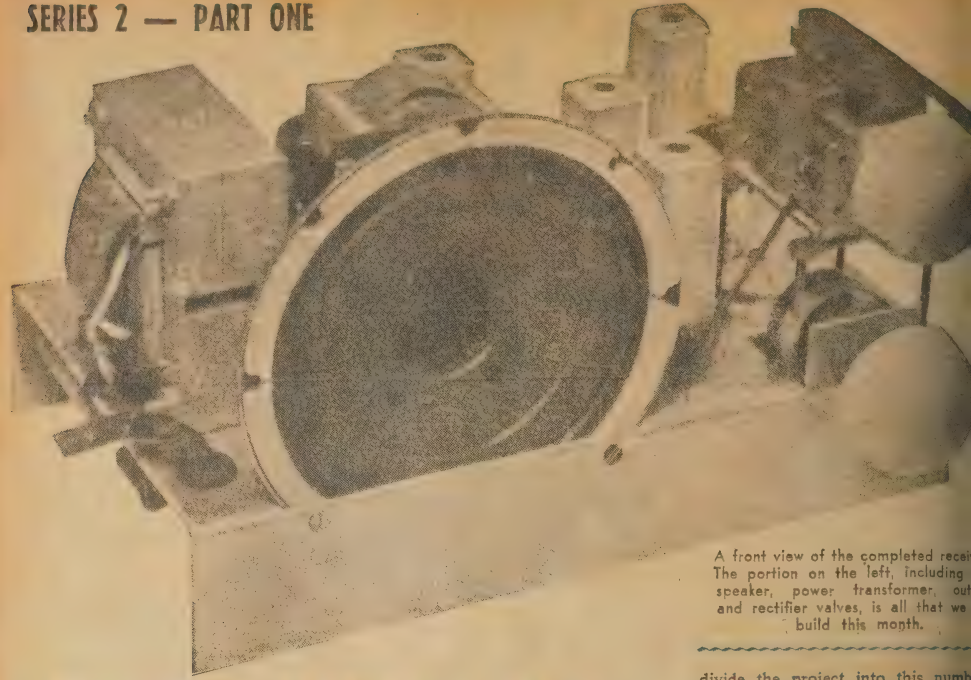
SERIES 2 — PART ONE



A front view of the completed recei
The portion on the left, including
speaker, power transformer, out
and rectifier valves, is all that we
build this month.

Learn While You Build A Receiver

Here is the first of a series of articles aimed directly at our beginners. If you have never bui anything more than a crystal set—or even if you have never built anything—there is st no reason why you should not start right now to build yourself a "real" set. As well producing something useful, you'll learn a lot and have a lot of fun into the bargain.

by Philip Watson

Beginner's projects must be the most consistent demand we encounter in our reader's mail. With young (and not so young) enthusiasts continually joining our ranks, it is not surprising that there is an almost continual demand for projects of this kind; projects which are simple, reasonably economical, and satisfying—as well as providing a groundwork of knowledge from which more ambitious things may be tackled.

NOT FORGOTTEN

Our recent excursions into the realm of TV have brought some accusations that we are neglecting or have abandoned this section of our readers. They may rest assured that this is not so. We have no intention of losing sight of their needs, even though these must, of necessity, be shared with the needs of all our other readers.

There are many ways in which we can attempt to satisfy these demands. Crystal sets, one and two valve sets, simple record players and similar projects have been described in the recent past and, together with the recent "Course in Radio" series, are all excellent material for the beginner.

Another approach is to describe something rather more ambitious, such as a conventional receiver, but to spread the description over several issues, and divide the project into this numb small sections.

In this way the beginner is not to tackle anything larger or more plex at any one time than wou presented by, say, a simple two set, yet he is progressing steadily t something far more rewarding—a radio set which is in no sense or a novelty.

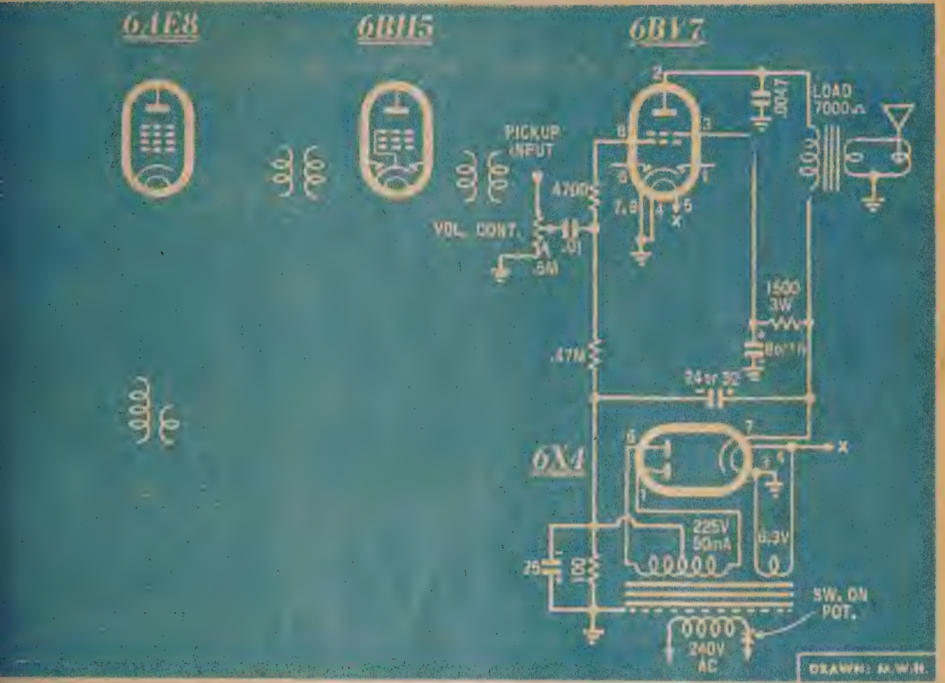
Although some previous experie always a help, and this project appeal particularly to those who tried their hands at some of the s sets, we aim to present the desc in a manner which will allow eve beginner to follow it without diff Thus, there is no reason why you not tackle a project of this size a first set, even though such a pro may seem a little unconventional.

A further advantage of doing t on the instalment plan is the financial one. Doing it this way will not have to lay out the ful of the parts before you get starte only for those required for each as it is commenced.

TYPE OF SET

In more specific terms, the se are about to build is a typical fou mantel set, employing the super dyne circuit, using the latest comp and quite comparable in perfor with similar size commercial set can also make your own cabin will tell you how to do that, to

RST SECTION — POWER SUPPLY & OUTPUT STAGE



the portion of the circuit we will be using this month. It includes the power supply and power output stage, and is really a simple audio amplifier. If circuits are strange to you, try working out this small section—it's not really hard.

ned set will be something you proud to own, not only for its nce. but because you can say, it myself."

sual valve "line up" for sets of is a frequency converter, an fier, a power output valve, and r, and this is the arrangement d in our set. In spite of the these sets employ only three alves (i.e., excluding the recti- still have adequate sensitivity ocal listening requirements, and an excellent compromise be- erformance and cost. They are one of the most popular types n Australia today.

rst section we propose to build ower supply and power output his will be followed in subse- sues by the IF stage, detector C section; and finally, the aerial, , and converter stages.

G A START

arting with the power supply ver output stage we greatly the job of checking our first when it is complete. The power vill have a nearly normal load ch to work, and so will deliver nately correct voltages. If it ve will know there is something nd the trouble can be traced rected before the set becomes plex.

rly the power output stage can to work, and even deliver sig- he speaker if we can provide a suitable signal source, such as a pickup. allowing us to be quite sure that this is working properly before we commence the second stage.

Since we hope to give you some idea of the "why" as well as the "how" we will endeavour to explain something of what goes on in each section before we tell you how to build it. That way you will not be working completely "blind."

If you intend to follow radio seriously as a hobby one of the first things is to learn to follow a circuit diagram. While this method of presentation may seem strange and difficult at first, it is really used because it is the easiest and most satisfactory.

As a help to get you started we are printing drawings of the most popularly used circuit symbols, as well as a normal circuit of the section we are to tackle this month. We suggest you study this circuit, and the symbols, during the discussion which is to follow.

The power supply is the first thing to consider. This is designed to take the power from the supply mains and convert it into the various values and type of power we require to operate the set. Let us see just how it does this.

The major component is the power transformer. It is to be found right at the bottom of the circuit and it is not hard to imagine that it consists of three windings on an iron core. One winding (the primary) is shown connected to the 240 V AC mains, while the two secon-

PARTS LIST

1 Chassis 9in. x 5½in. x 1¾in.
1 Power transformer type PF201.
1 5in. loudspeaker type 5C.
1 Speaker transformer 7000 ohm, type EBG96.
1 6BV7 valve.
1 6X4 valve.
1 Miniature 9 pin socket.
1 Miniature 7 pin socket.
1 7 tag terminal strip.
1 5 tag terminal strip.
1 4 tag terminal strip.
1 3 tag terminal strip.
3 ⅜in. grommets.
2 ¼in. grommets.
Hook-up wire, 18 gauge tinned copper wire, 3 core power flex, 3 pin plug, nuts and bolts (2 countersunk for speaker mounting) solder lugs, solder &c.

RESISTORS
1 .5M potentiometer with single circuit switch.
1 .47M ½W.
1 4700 ohm ½W.
1 1500 ohm 3W.
1 100 ohm ½W.

CAPACITORS
1 32 mfd electro. 350PV.
1 25 mfd electro. 40PV.
1 16 mfd electro. 350PV.
1 .01 mfd paper 400V.
1 .0047 mfd paper 400V.

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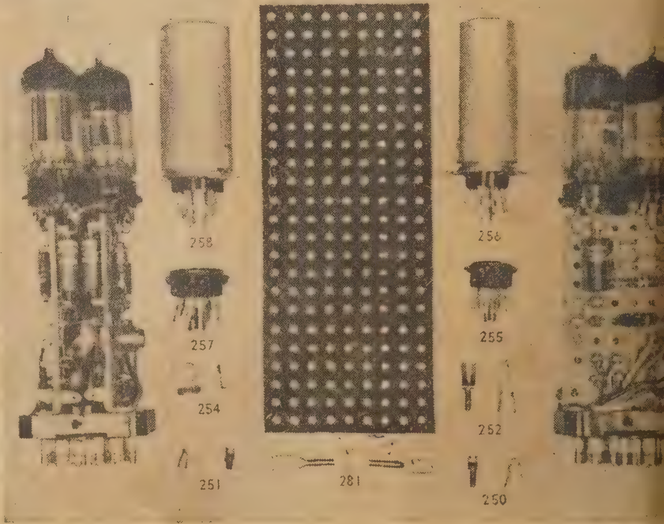

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vindings supply high and low to operate the set.

implest requirement is to energise e heaters. These operate at 6.3 draw between .3 and .8 amp. g. to type. and are quite happy alternating supply. So we provide ng on the transformer delivering s at up to 2 amps: This is the inding on the right.

next requirement is the HT This is not quite so simple, needs to be a direct supply than alternating. We start by g a HT secondary winding, apped and having a voltage on de approximately equal to the oltage we require. This is the vinding marked "225V 50 mA."

NDARY WINDING

secondary winding is connected rectifier valve (the 6X4 pins) and this performs the function erting the alternating voltage to oltage (rectifying). The valve is wo rectifiers in one, the two nployed to provide "full wave" ion, or the utilisation of both of the alternating supply. The voltage appears at the 6X4 (pin 7).

e rectifier cannot complete the can make the supply direct, sense that it is flowing in the ction, but it cannot make it a smooth supply. As it comes rectifier it contains a very high ontent, a characteristic which ive rise to severe hum in the

is eliminated by means of a work. The components used for very high value capacitors ytics) and chokes or resistors. are most efficient. but are more e and bulky. In small sets, such ne, it is often possible to provide adequate filtering by means heaper and smaller resistor. In uit the capacitors marked "8 or 4 or 32," and "25" are the ts. together with the "1500 ohm istor.

FOR 6BV7

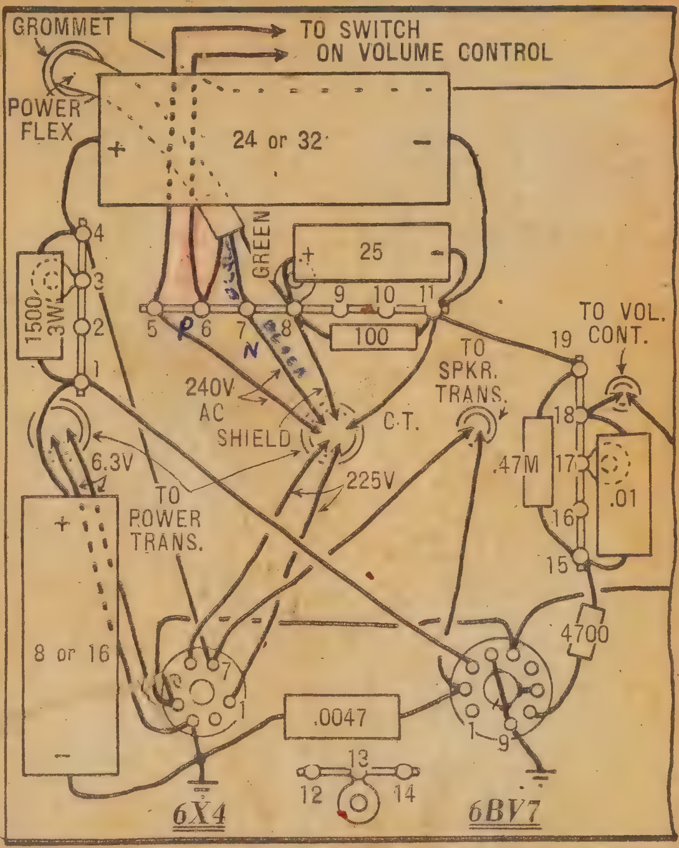
to somewhat different require- is possible to feed different the circuit from different parts ilter network. In this case the late is supplied from the. first pacitor (where the voltage is while the remainder of the set power from the second capaci- where the filtering is better.

one remaining section of the upply is the 100 ohm resistor e HT winding centre tap to earth). This is to provide "bias," negative voltage required for of the various valves to pro- rect operation. This system is as "back bias."

let us consider the 6BV7. This a power valve, since its function eliver power (as distinct from or current alone) to the loud- The more power it can deliver e noise you can make before l commences to distort.

lso an amplifier valve, since the delivers to the loudspeaker are mes stronger than those it re- rom the previous stage. As a lification we call it an "audio"

ASSEMBLY & WIRING DETAILS



This diagram shows the location of the parts under the chassis as well as the wiring. Compare it with the photograph on the next page, and check it against the circuit on page 49.

amplifier, because the signal it handles is audible.

By audible signals we mean signals that require only to be fed to a loudspeaker or a pair of headphones in order to be heard. Typical examples of audio signals are those produced by microphones, pickups, and (as in this case) the detector of a receiver. In the normal way all we ever need to do with these signals is amplify them until they are strong enough to operate a loudspeaker, headphones, or similar device.

TYPES OF SIGNAL

The reason we find it necessary to classify the type of signal is because, in other parts of the circuit, we have valves amplifying quite different types of signals. These are called "RF" (radio frequency) or "IF" (intermediate frequency) signals, and we will have more to say about these later on.

In addition to the heater (pins 4 and 5) this valve has a cathode (7, 9), two diode plates (1 and 6), a control grid (8), a screen grid (3), and a plate (2). All these connections are brought out to a miniature 9-pin base.

Signals we wish to amplify are applied between the control grid and the cathode. In this case the audio signals first appear across the volume control (.5M, extreme left of the diagram) and are coupled through the .01 capacitor to appear across the .47M grid resistor.

SIGNAL PATH

Tracing out from each end of this resistor we find that the upper end connects to the grid (we can ignore the 4700 ohm resistor for the moment) and the lower end to the cathode via the bias network and chassis. Thus the signal is applied between grid and cathode.

The amplified signal now appears between the plate and the cathode. Since we require this signal in the speaker (extreme right of the circuit) we connect the speaker between plate and cathode. You should have no difficulty in tracing the connection from the plate to the top of the speaker transformer, but tracing the other end of the trans-

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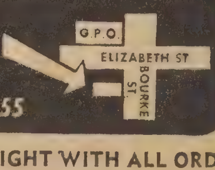

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: back to the 6BV7 cathode is easy.

the present you will have to oı less take our word for it, but rcuit is via the electrolytic capa- in the power supply and which ally connect to chassis and so cathode. The two diode plates t required at this stage.

s this single valve, plus the supply, constitutes a complete, ole, audio amplifier. It will deliver ch power to the speaker as the will comfortably handle, and it fully driven by a comparatively signal voltage on the grid.

E VOLTAGE

maximum voltage required is in cinity of 4.5 while signals as low volt would still produce a useful e. Since many crystal pickups are e of delivering signals of the or- several volts, particularly from assages, it is easy to imagine that these might be fed straight into lume control and deliver a worth- signal from the speaker.

is quite practical, and we have ed several simple record players past based on this principle. The art of your set, therefore, may ployed in this role if you have a available, and it is an excellent test it.

nuch, then, for the theory of our w let us consider how we are to ctually constructing it. Elsewhere article you will find a list of the ou will require for this section, e first thing to do is to take this dio dealer and ask him to supply rts listed.

have made this list as detailed sible in order that you will be d with parts as nearly as possible al with those we used. In most here are many components avail- aving identical electrical charact- , but which differ widely in their al dimensions. Where this is likely important we have specified the umber of the preferred version.

S LIST

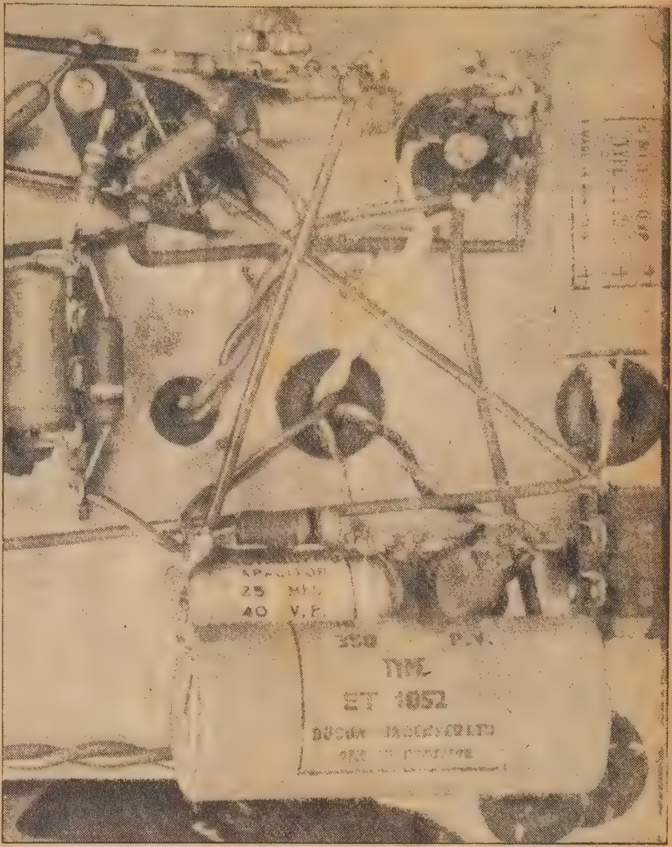
r kit of parts will consist of a ounched chassis, a power trans- , speaker, speaker transformer separate or mounted on the), the two valves, and a collection stors and capacitors. Also make ou have hook-up wire, solder, lugs, nuts and bolts and some ge tinned copper wire.

you wish to make your own , a blueprint will be available in ual way. However, the use of a nade chassis is a considerable o the beginner, and costs very nore than a home-made one. All considered, we suggest it is the proposition.)

first-step is the assembly. This is a "nut and bolt" operation, or ounting of the major components r correct position on the chassis, hould be completed before any t is made to tackle the wiring. assist you in this we have pre- a detailed layout and wiring diag- owing the position of components eath the chassis as well as the However, for the present we are ned only with placing and orient- of components, particularly the sockets, power transformer, and al strips.

re mounting the transformer, fit the three 3/8in grommets and the two ¼in grommets in the chassis holes indicated. These are necessary to prevent the edge of the chassis from cutting vital leads where they pass through it. These may appear too large for their respective holes at first sight, but a little patience will allow them to be fitted.

WIRING & ASSEMBLY PICTURE



A photograph of the relevant portion of the chassis underside. Compare it with the wiring diagram on the previous page, remembering that there are some components in this picture which are not yet required. These will be discussed next month.

The speaker is mounted above the chassis in the cut-out provided and secured to the front of the chassis by two mounting bolts. If the speaker transformer has been supplied separately it should be bolted to the bracket on the speaker frame in the general position shown in the photographs.

This transformer is fitted with four leads. Two are of plastic hook-up wire and connect to the primary, and two are single strands in spaghetti tubing and connect to the secondary. The two secondary leads should be connected to the two eyelet type terminals on the speaker frame. The primary leads may be in two different colours, but this is of no significance in this circuit.

With all the major components mounted, we can commence the actual wiring. An experienced person would be able to do this by reference to the circuit diagram alone, and this is a standard of ability at which you should aim. However, we have also provided the wiring diagram, plus a detailed description of the wiring, and you should have no difficulty in following these latter. At the same time, try following the circuit as you go; it will provide excellent practice.

EARTH CONNECTIONS

Our first job concerns "earth" or chassis connections. You will see a number of these earth signs in both the circuit and wiring diagram, and they simply mean that the wire concerned must be securely connected to the chassis.

In practice, this presents some minor problems. Ideally the connections should be soldered, but both steel and aluminium chassis present difficulties. Soldering to aluminium is virtually "out" as far as ordinary techniques are concerned, but a satisfactory connection

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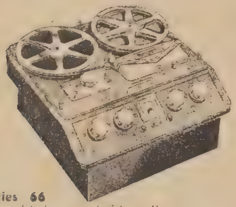
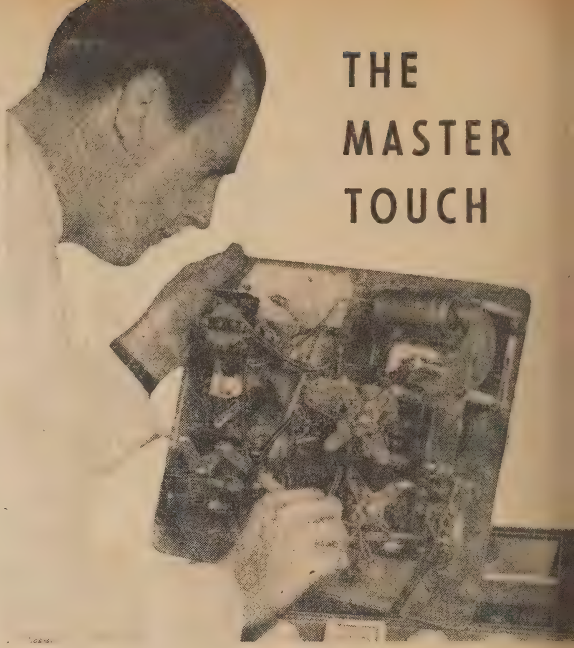
Model 3A/NH 7½ and 15 i.p.s.
Including 7in reel of Ferrotape.



Series 66
In gold bronze finish with cream controls for fitting to own cabinet
Model 66N 3¾ and 7½ i.p.s
Model 66H 7½ and 15 i.p.s
Including 8¼in reel of Ferrotape.

STEREO SERIES
Model 77,
3¾ and 7½ i.p.s. for normal monaural recording and playback (with monitoring) and for reproduction of commercial stereo tapes
Model 88,
7½ and 15 i.p.s. for full stereophonic recording and playback Also for monaural full track recording playback
Including 7in reel of Ferrotape.
Note: Both Models 77 and 88 require addition of external amplifiers and loudspeakers.

THE MASTER TOUCH



IN THESE DAYS of impressive assembly lines—of ever-moving con veyor belts — of the advent of automation — it is well to remember that there are still products whose good name depends upon th traditional skill of the British craftsman

Such a one is the Ferrograph — today freely acknowledged to b without equal in the field of magnetic tape recording.

In Australia, chosen by Government Departments, by the Services by Broadcasting Stations, by Schools, by High Fidelity enthusiasts, b industry and research workers, by famous explorers and anthropologists whose sound recordings on tape are such an essential part o their work, by news commentators and those who travel the worl to bring back recorded impressions, the Ferrograph owes much t those craftsmen who guard so zealously its unique reputation.

In the manufacture of a Ferrograph there is the closest control o every assembly operation The tests to which every instrument i subjected are the most exacting that can be devised. Of course, suc high standards of fidelity and performance cost money. But thos who choose the Ferrograph are making a life-time purchase — the are the wise (and fortunate) ones to whom ultimate satisfaction an performance count so much more than initial cost.

THE INCOMPARABLE Ferrograph

TAPE RECORDERS PTY. LTD.

DEMONSTRATIONS
AND SUPPLIES
AVAILABLE FROM:

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MELBOURNE:
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Gerard & Goodman Ltd., 192 Rundle Street
BRISBANE:
Chandlers Pty. Ltd., Cnr. Albert & Charlotte Sts
PERTH:
Leroya Industries Pty. Ltd., 672 Hay Street

e made by anchoring a soldei der a convenient mounting bolt eel chassis can be soldered, but s a larger than average iron and ain amount of care. For this it is seldom attempted by the r. The solder lug technique as e aluminium chassis is also less tory due to the possibility of rming on the steel surface and ng the performance of the set ater date.

best way to overcome this is to all the solder lugs required (see diagram) and then connect them gether with bare tinned coppei 8 gauge is a handy size and it be straightened by stretching before being used. Note that these "earth" connections is one one (either) side of the speaker rmer secondary.

SFORMER LEADS

, identify the power transformei from the code supplied with it sure of this when you purchase arts) and select the primary (240 eads. Note that in some cases will be coloured black and red, another lead, the secondary centre ay also be black. Confusion can oided by noting the grouping of ds where they enter the side of nding.

e is, in fact, no particular signi- in the red and black primary in this case and they may be ted either way round. They are ted to two tags on the seven l strip and, to make it easier u to follow our instructions, we mbering the terminal tags on the diagram and will refer to these umbers" in our description.

5 and 7 are the two used in ase, while the incoming power rminates on tag 8 (green-earth), (black-neutral), and tag 6 (red- A twisted pair made from hook- e runs from tags 5 and 6 to the control switch.

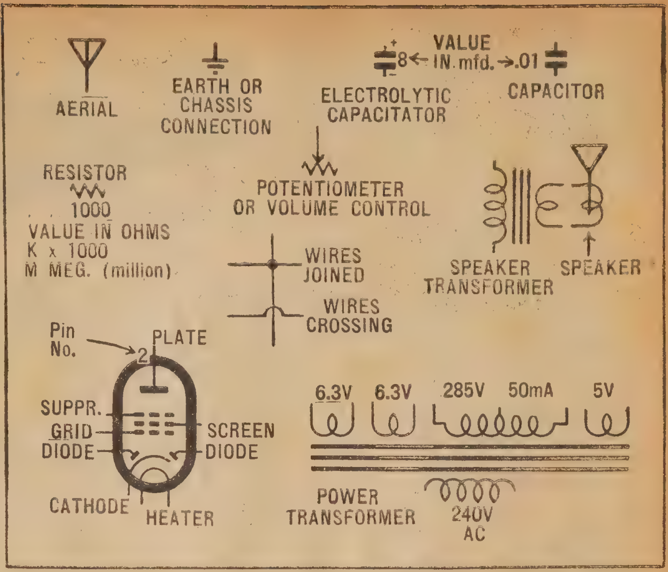
ere are only two terminals on itch there will be no confusion, ne units may have four. In such nly two will be required, and it necessary to find a "pair." This e done by setting the switch to ON' position and checking for ity with an ohm meter or other continuity tester, such as a and lamp.

ER CORD

incoming power cord must have n knot between the terminal strip e chassis, in the interest of safety e pin plug is fitted to the opposite nd extreme care must be taken that the wire connecting to the r chassis (normally green) is con- to the earth pin on the plug. this connection first to avoid on.

e may be a thin cotton covered om the transformer, and this is minate an "electro-static shield" n primary and secondary. Its pur- to minimise signal being fed to from the mains, and is simply ted to the nearest available chassis tion. (Tag 8).

two heavy leads in tubing are the it [illegible] These should be twisted er and trimmed to a convenient for connection to the 6X4 Before attempting to solder these



Here are a selection of symbols such as used in the circuit on page 49. Acquaint yourself with each of these, then try following the circuit. If necessary refer to the wiring diagram also. Additional symbols will be given next month to cover the new section.

to the socket pins the enamel must be removed and the wire tinned.

In addition, one pin (No. 3 is easiest) requires to be earthed to the chassis. A short length of tinned copper wire should be passed through the socket lug and soldered to the lug previously mounted under the mounting bolt. However, don't solder the wire to the socket lug until the transformer filament lead has been slipped into place with it.

Pin four is treated similarly, except that the second wire is a length of hook-up wire which will ultimately run to the next socket.

Three leads remain, being the centre tap and two ends of the HT secondary winding. The two ends (probably yellow) are twisted and trimmed for connection to pins 1 and 6 of the 6X4. The centre tap goes to lug 11.

This completes the wiring of the power transformer. It is a good idea to check this much of your work carefully before going any further.

If this much appears to be OK, we can mount some of the smaller components. The 100 ohm back-bias resistor connects between tags 11 and 8, as does the 25 mfd electrolytic. The latter must have the positive (red) end to tag 8. The 32 mfd connects between tags 4 and 11, with the positive end to tag 4

SOCKET CONNECTIONS

The 1500 ohm 3 watt resistor connects between tags 1 and 4, the positive end of the 16 mfd also connecting to tag 1. The negative end goes to chassis via the lug under the 6X4 socket. Tag 4 is connected to 6X4 pin 7.

Next we attack the 6BV7 socket. The short length of hook-up wire previously connected to 6X4 pin 4 is now trimmed and fitted to 6BV7 pin 5, while another short length is also fitted before soldering the connection. This latter is for ultimate connection to the next valve. In the meantime make sure the free end cannot short to the chassis.

Now a short length of tinned copper wire must be run from pin 4, through the central shield to pin 9, and then to the chassis lug. Pin 7 is soldered direct to the central shield. Note that the central shield can usually be rotated with a pair of pliers until the small hole is in a suitable position.

Twist together the two speaker transformer primary leads, pass them through the chassis hole near the power transformer, and connect one to 6BV7 pin 2 (plate) and the other to 6X4 pin 7 (cathode). A lead from 6BV7 pin 3 (screen) connects to terminal strip tag 1. A .0047 mfd capacitor connects between pin 2 and the chassis lug under the 6X4 socket.

LAST STAGES

The 4700 ohm resistor connects between pin 8 (grid) and tag 15, and a .47M between tag 15 and tag 19. A short length of hook-up wire bridges tag 19 to tag 11. From tag 15 a .01 mfd capacitor connects to tag 18 and from this point a length of hook-up wire (one of a twisted pair) runs to the moving arm (centre terminal) of the volume control.

Looking at the front of the volume control, select the most clockwise terminal and connect it to chassis. The metal housing of the volume control will serve in most cases, provided the control is securely mounted with the lockwasher provided. The remaining terminal is the "active" into which the audio signal to be amplified is fed. For the moment it connects to the other wire of the twisted pair, the opposite end of which is left free and about three inches long on the underside of the chassis.

This completes the wiring and, if all has been carried out correctly (and we

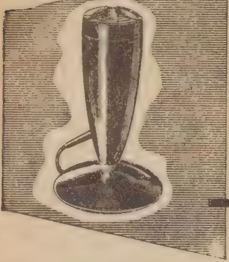
(Continued on Page 127)

acos

A COMPLETE RANGE

CRYSTAL MICROPHONES MICROPHONE INSERTS

FOR EVERY PURPOSE



DESK or HAND MICROPHONE, MIC36

This Microphone is ideal for home recording and public address, etc. Response unexcelled for its size and price. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost **PRICE, £6/18/6**.

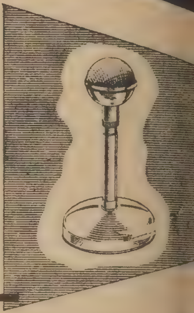
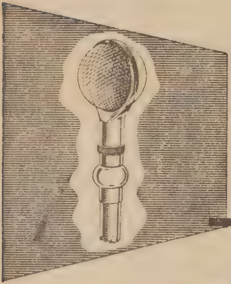


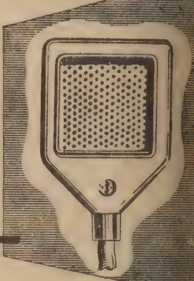
TABLE or STAND MICROPHONE, MIC22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the equation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost. **PRICE, £9/18/6.**



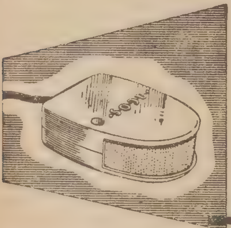
HIGH-QUALITY MICROPHONE, MIC16

This Microphone incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock. The fidelity is not impaired by low frequency noise. **PRICE, £24/19/6.**



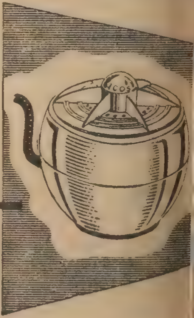
LAPEL MICROPHONE, MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel. **PRICE, £5/19/6.**



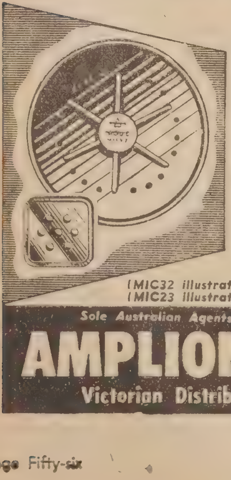
GENERAL PURPOSE, MIC35

The MIC35, is ideal for amateur transmitters, public address, etc. Housed in an attractive die-cast case, it features a high sensitivity and substanially flat characteristics. Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s **PRICE, £2/15/-.**



HAND or DESK MICROPHONE, MIC33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s **PRICE, £6/18/6.**



(MIC32 illustrated)
(MIC23 illustrated)

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as $\frac{15}{16}$ in. square to 1-$\frac{13}{16}$ in. round, with various thicknesses from $\frac{7}{32}$ in. to $\frac{9}{16}$ in Suitable for every purpose, such as hearing aids, public address tape recording, amateur transmitters, etc., they have responses from 2,250 c.p.s. to 3,500 c.p.s. at -5 db to -30 db. Insert can be supplied with or without 10 meg. resistor as required.

MIC19/4 and MIC32, **£2/15/6**; all others, **£1/19/6.**

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Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

ROM THE SERVICEMAN WHO TELLS

e you ever noticed how one sometimes encounters a "run" of sets having similar faults? had three this month; all variations on the one theme — leaky coupling capacitors. What's more, they occurred in three widely differing pieces of equipment.

st case concerned one of the ortable receivers designed to om either batteries or a built- supply. The owner complained set distorted very badly after or a short time, recovering y if switched off for an equi- riod, then building up to a condition again.

liately wanted to know whether occurred on both battery and eration, but the owner was a on this point.

you the truth," he said, "we it much on batteries. It's some nce we took it out of doors, sits on the kitchen shelf and t the wife's serials. In fact," "I suppose we use it for most istening really."

n wonder why set designers provide upwards of four watts udio when a couple of hundred — distorted — seems to be dequate for so many listeners. that's another story.)

ON BATTERIES

e owner was unable to help switched the set over to its ries and let it run for half or so. Reproduction seemed n—for a portable—and re- for the whole of the test

established that much I it over to its power supply ked again. The reproduction lean, and I put it aside again t would happen.

have long to wait. Even after utes I imagined I could detect ortion, and at the end of 10 e announcer was talking with l of plums and a symphony sounded like a skiffle group

On opening the cabinet the first thing that struck me was the position of the power supply, and in particular the heat-producing transformer and rectifier, which were directly under the power output stage. It seemed inevitable that there would be a tie-up between the two in some way.

My first guess was that the output valve was mildly gassy and that the extra heat was enough to aggravate this condition to the point where it became noticeable. Since this valve was easily accessible and I had another handy, it was a natural thing to simply swap them over.

NOT THE VALVE

My theory was quickly shattered when the new valve behaved—immediately—exactly as the other had done. If it was the output stage, it certainly wasn't the valve.

Adopting a more scientific approach, and still having the impression that it was the output stage, I traced out the plate circuit and connected a milliamp meter in series with it, allowing the set time to cool while I was setting things up.

When I switched on again the set played normally and the plate current read 7.5 mA—a figure which I regarded as fairly normal. However, the current started to creep almost immediately and, at the end of 10 minutes when the distortion was once again rife, it was up to nearly 12 mA., at which point it seemed to stabilise.

Switching off for a moment, I quickly disconnected the coupling capacitor from the previous stage and switched on again. The current was back to 7.5 mA and remained perfectly steady while I watched it closely for several minutes.

There seemed little doubt now that the coupling capacitor was the culprit and, while there is nothing unique about a leaky coupling capacitor, the fact that it only failed when overheated did make it rather unusual.

I removed the faulty capacitor, fitted a new one, and gave the set another test. When it seemed to be functioning correctly after about 10 minutes, I turned my attention to the faulty capacitor. Purely for my own satisfaction I switched on the R/C bridge and connected the capacitor across the leakage indicator terminals.

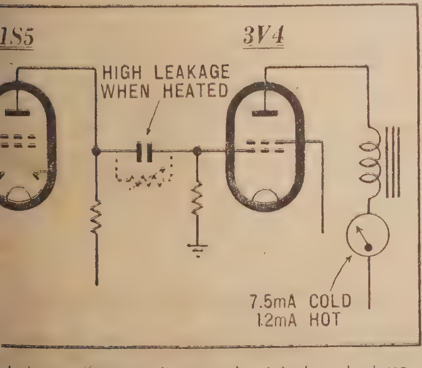
It was back to room temperature now and the leakage showed as a series of flashes at about one second intervals; rather more than I would like to see in a coupling capacitor, but not a really serious leakage.

Then I picked up the soldering iron and held the barrel directly under the capacitor. Almost immediately the rate of flashing commenced to increase, and went right on increasing until the speed was so great that the flashes merged into a continuous glow. With the iron removed the rate dropped quickly to its original "one a second."

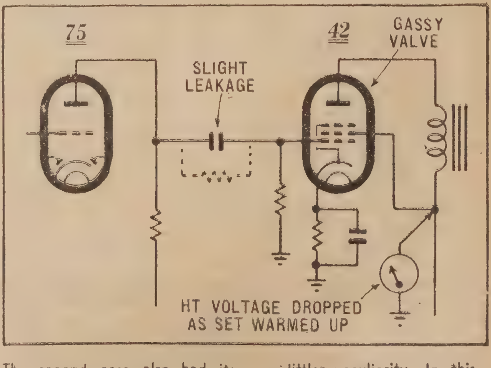
HEAT TEST

Had I needed any further proof that this was the culprit, then this test would most certainly have provided it. As it happened, I didn't, but I can easily imagine plenty of cases where substitution or other tests may not be so conclusive, and a check of this kind may be very valuable.

My next set was a rather unique old-timer. If my memory serves me correctly it would be about 1936 or '37 vintage. This was a period in which the term "miniaturisation" was virtually unheard of, and sets always strove to be bigger



leaky coupling capacitor turned out to be a heat sen- ersion—just to make it harder! It was only when the power supply was used that trouble occurred, the output eing directly above the rectifier and power transformer.



The second case also had its own little peculiarity. In this case the leakage was not sufficient in itself to cause noticeable distortion, but it did show up a gassy output valve and was probably responsible for making it that way.

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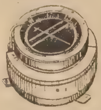

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re elaborate than their com-

ne was no exception. In addition big physically, it boasted a porate tuning mechanism. In the f the regular dial—large and e enough in its own right— a selector fashioned along the a telephone dial. This could to "dial" any one of the eight tions, normal variable tuning, ve, or "Gram."

unately, its impressiveness fini- its appearance. When switched et was weak, had a nasty hum l a bad rattle in the speaker. e "telephone" dial seemed to itive indexing, so that it was ally possible for a careless to set it between two stations, an the one required. Altogether formidable list of troubles.

wner was an elderly lady of nited means, and I realised that could be a costly one; perhaps stly than she could afford. I that some compromise might be struck between what was and what was economical.

H TROUBLE

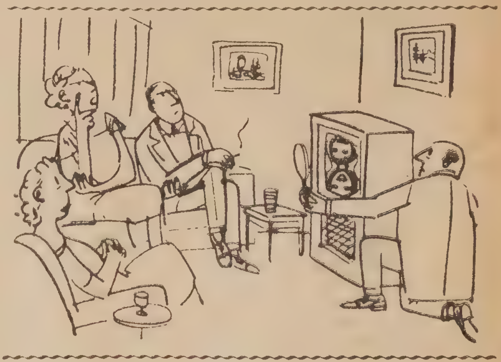
ce under the chassis was suffi- reveal the dial trouble. As I cted the telephone dial simply an eleven-position switch (one der types no longer in produc- the two indexing arms on the late had succumbed to old age. , it was a classic case of metal the two arms having fractured ey joined the main shaft. One en away completely, while the s hanging by a mere scrap of d quite incapable of performing ul function. It seemed safe to hat the set had been operated clusively on the telephone dial.

er, I was less interested in this moment than in the electrical . A check on the HT voltage t revealing, being only a little volts. This led in turn to the a poor decrepit 80 trying to keep going in spite of its

A new one helped matters considerably, but the HT was still on the low side. Remembering the hum I turned my attention to the electrolytics, both of which appeared to be fairly old. The first one was the most obvious culprit, and a new one restored the remainder of the missing HT volts and removed most of the hum. The second one was less obviously faulty, but I changed it anyway on principle.

The set was sounding better already. The hum had vanished, while the correct HT voltage seemed to have restored normal sensitivity. Only the speaker rattle remained to mar the performance.

This presented something of a problem. The speaker was certainly too old to return to the makers for repair, while, being an electro-dynamic type, replacement might be difficult. The only alternative seemed to be the fitting of a new permag type, plus a filter choke and dropping resistor.



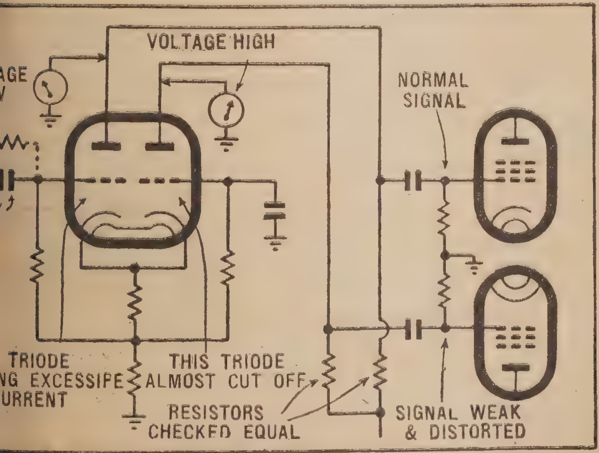
☆

"Couldn't we just have it as bad as it was before?"

☆

While a perfectly satisfactory approach, the cost of the new speaker, plus additional parts, plus labour charges, would all add up to a fair sum. With other charges already incurred, or in sight, it could easily prove an embarrassment to the owner.

I took another look at the speaker. It was not the type which lent itself to repairs on the service bench, even supposing that the time could be justified, which was doubtful. On the other hand the degree of rattle was not severe, and I considered it might be worth trying a few simple "wangles."



er three was different again. Being part of phase changer stage it caused de to produce very weak and distorted signals, completely ruining the per- ce of a high power amplifier. Because the symptoms were rather unusual, it required some careful checking to track it down.

One trick is simply to vary the pressure of the mounting screws, thus slightly distorting the frame and, if you're lucky, correcting the centring. However, the one which proved most satisfactory on this occasion was one of the simplest of all. I simply turned the speaker the other way up.

Apparently the suspension systems in some of these old speakers were prone to sag ever so slightly after many years' use, thus allowing the voice coil's own weight to drag it off centre. Turning it over simply reverses the procedure, the weight now pulling toward the centre. Of course, in another 20 years . . . but I doubt if I'll be worrying about that.

In this case the cure was not complete, but the improvement was considerable. At normal levels the rattle was virtually absent, though it would show up on some of the louder passages. Since I felt it unlikely that it would ever be driven at all hard in its own home, it seemed that my "cure" was adequate, particularly as there seemed to be a chance that it might get better rather than worse as time went on.

With the speaker functioning better the set sounded quite reasonable, and I considered the various electrical problems solved. The next point to consider was the broken switch, and I left the set running while I pondered the best solution to the problem.

It was while I was thus meditating, and after the set had been running for about 15 minutes, that I realised that all was not well. The reproduction was no longer clean, but had a definite "edge" on it.

I let it run for a few more minutes, and the distortion increased noticeably during this time. It seemed that I hadn't finished with the electrical problems after all.

DROP IN VOLTAGE

A check on the HT voltage showed that it had dropped noticeably. This fact suggested that the output valve was drawing excessive current and, in turn, that positive voltage was building up on the grid.

Disconnecting the coupling capacitor from the grid restored most of the HT voltage, though it still seemed short of its previous best. Next I checked for any sign of positive voltage on the grid side of the disconnected coupling capacitor. Sure enough, there was a small but perceptible deflection of the needle; a clear indication of a leaky coupling capacitor.

Next I touched the meter prod on the grid of the output valve and was rather surprised to discover a positive indication here also, in spite of the dis-

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0.05/200v.	1/2 ea.
0.05/400v.	1/4 ea.
0.05/600v.	1/7 ea.
0.1/200v.	1/2 ea.
0.1/400v.	1/9 ea.
0.1/600v.	2/- ea.
0.25/200v.	2/- ea.
0.25/400v.	2/5 ea.
0.25/600v.	2/11 ea.
0.5/200v.	2/7 ea.
0.5/400v.	3/11 ea.
0.5/600v.	4/1 ea.

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1 x 12 x 3	31/4
2 x 4 x 3	24/10
2 x 5 x 1	11/7
2 x 5 x 2	17/10
2 x 5 x 3	24/10
3 x 3 x 1	11/7
3 x 3 x 2	17/10
3 x 3 x 3	24/10
4 x 2 x 1	11/7
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4 x 2 x 3	24/10
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6 x 2 x 2	23/10
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ted capacitor. This is an almost certain indication of a gassy so it seemed there were two in this part of the circuit, both uting to the same trouble.

ict, it seems most likely that the coupling capacitor occurred first, sultant over-running of the outlve causing it to become gassy. as I regretted it, there seemed no tive but to replace the valve, as fitting a new coupling capacitor. that was leaky coupling capaumber two; one that I very neared by reason of the time needed o show up. Presumably, the order age was not enough in itself to bvious disturbance to the output out it was enough to start a slow f grid emission, increased cathode higher temperature, more grid n, etc., building up over a of about 20 minutes from a dead art.

SWITCH AGAIN

I returned to the problem of ken switch. As with the speaker, s mainly an economic one, and o decide just how much expense e justified.

switch was almost completely by the broadcast and short wave d the array of trimmers associat each channel. To replace the or even the clicker plate and would mean that the entire coil nmer assembly would have to be out and subsequently replaced.

e quite feasible technically, such was going to take a lot of time cost might be hard to justify. as I had been able to see the as not causing any inconvenience, ner apparently having adapted to it, if, in fact, she even noticed

lly decided that this was a case could benefit the customer most ing a fault in the set, rather than o correct it.

left only a routine alignment to e the job, assuming nothing showed up in the process. The hat struck me most about this of the set was the remarkable of the fixed tuned circuits as with each of the eight switched s. I knew enough about the of the set to know that these t been touched for many years, y were virtually "spot on" for annel.

RD ONE

n't know whether this was the of good engineering, good luck, tle of both. In general, however, d tuned sets have never been reas much of a proposition, if only of this very problem. Except in xpensive designs employing AFC atic Frequency Control) the prof ensuring that the set will be ely tuned to the station selected ery serious one. And unless it ine accurately it is worse than

not easy to make physical verf "L" and "C" which will rebsolutely constant regardless of ture and other atmospheric varilus normal vibration and hand fact, it is near enough to im, and certainly not in any sense iomic proposition.

ourse, they don't have to be tely constant," but the amount of drift which can be tolerated is very small, even allowing for some unconscious tolerance on the part of the average user.

As a result, the few sets designed along these lines have never been regarded as overwhelmingly successful, and it is significant that the idea has been almost completely abandoned in recent years.

All the more reason, therefore, for my interest in this set and its high order of stability, even though I can offer no explanation why this was so. Neither have I encountered enough of this model to be able to say whether it is a natural characteristic or merely a fluke.

Quite naturally, the alignment was a bigger job than usual. The IF channel was perfectly normal, but the broadcast trimmers took a little working out. The eight switched channels had been achieved by connecting various values of capacitance across the main broadcast aerial and oscillator coils.

Also, because of the dual-wave facility, the regular broadcast trimmers could not be connected across the gang, and had to be mounted permanently across the coils. Thus, any disturbance of these two trimmers would upset the entire switched channel system, meaning that it was essential that they be adjusted and sealed before any attempt was made to adjust the switched trimmers.

Simple enough when you work it out; but a nasty trap for the unwary.

And so I was able to return the set to the customer in satisfactory working order without involving her in more expense than was absolutely necessary. She was extremely grateful that the charge was so reasonable and any lingering doubts I had about the measures I had adopted were quickly dispelled.

A PA SYSTEM

Story number three concerned a moderately high powered public address amplifier which had been built by an enthusiastic amateur for use by a local charitable organisation. He apparently had had no difficulty in getting it working but, even without making any measurements, it was quickly apparent that the power output was a long way short of the 30 watts or so the circuit was designed to give.

Lacking the facilities to check the performance in detail, and having tried the obvious things, he sought my aid to give the unit a complete check. It turned out to be a fairly conventional circuit using a couple of EL34s driven by a twin triode functioning as a cathode-coupled phase changer, preceded by a 6AU6 as a voltage amplifier.

Since power output was the factor in question, I commenced by setting up some gear to measure this with reasonable accuracy. Leaving the output transformer secondary completely open, I connected a heavy duty resistive load of correct value across the primary.

An AC voltmeter and a CRO also connected across the primary completed this section of the set-up, the other portion being the audio generator delivering 1000 cps into the input terminals. By driving the output up to overload point, the power being developed can be calculated from the AC voltage and load resistance.

This set-up quickly confirmed what the owner had said. The maximum power available at the overload level was a fraction over six watts, while it was apparent that the overload was occurring in anything but a symmetrical pattern. Quite obviously, something was very wrong.

The next thing I did was to disconnect the feedback loop. There is nothing more futile than trying to track down a source of distortion within a feedback loop. Regardless of where the distortion originates, it will be fed back to the input circuit and appear in all stages, making it impossible to detect the offending one. Naturally the input from the generator had to be reduced to compensate for the increased gain.

With the aid of the CRO I then checked the signal level at the grid of each output valve. I was gratified to discover that the signal at one was only a fraction of what it was at the other, and very distorted into the bargain. Well at least I was on the track.

UNBALANCED DRIVE

Tracing through the circuit I established that the valve receiving the weak drive was the "lower" one in a conventional circuit, and the one being driven from the cathode coupled section of the twin triode. It looked as though this was the faulty stage but, to make quite sure, I isolated it from the output valves by disconnecting both coupling capacitors. The signal from the two plates remained unbalanced as before.

At this point I suspected the twin triode and substituted a known good one. It made precisely no difference, thus killing that line of thought.

Next I measured the DC voltage at each plate and discovered that this was very much higher on the cathode coupled section than on the driven section. Since both sections should have been working under identical conditions, with equal plate loads, I immediately suspected a faulty plate load resistor.

Once again I drew a blank, the two resistors measuring as nearly equal as made no difference, leaving me a trifle bewildered for a few minutes. I studied the circuit again and could see little else around the twin triode that could cause trouble. Very little, that is, except the coupling capacitor to the 6AU6.

COUPLING CAPACITOR

Mainly because it was a little easier, I simply disconnected the 6AU6 plate load resistor from the HT supply, rather than unhook the capacitor itself. Then I checked the two plate voltages again, and was gratified to discover that they were now near enough to equal. There seemed little doubt that I had found the culprit.

Strangely enough, two capacitors lying on the bench—used, but not by any means old and battered—proved to be nearly as bad as the original, making three capacitors in a row which were not good enough for this application.

I was rather relieved, therefore, when a new one from stock proved to be OK, but I was inspired to wonder how often a lesser degree of leakage resulted in at least partially upsetting the balance of a phase changer.

Having found the culprit it was comparatively easy to work out the exact effect it had caused. By placing positive voltage on the grid of the first section it had increased the cathode current of this section and thus increased the bias developed across the cathode resistor.

Since this resistor was common to both sections the increased bias appeared between grid and cathode of the second

(Continued on Page 127)

Here's your answer, Tom!

This month's queries come from two sources. One is a Tom who, having looked throug a recent issue of our journal, put pen to paper in an effort to satisfy his curiosity and, t quote him, "to provide an interest to other beginners." The other is an experimenter wit problems on the use of alternative components and valves.

Having looked through a current issue of your magazine, I have found a number of terms which I would like explained. What are IF strips, unmodulated signals, HF circuits, potentiometers, EHT voltages and tag terminal strips?

Simple as these terms may appear to some, Tom, to the uninitiated they must be puzzling. The term "IF strip," for example, refers to the sub-assemblies consisting of valves and associate components of an Intermediate Frequency channel.

It is common practice in the design and construction of television receivers to build the video and sound IF channels on a sub-chassis which attaches to the main chassis. Using this method of construction, the IF channels may be prealigned, serviced or interchanged without disturbing the complete assembly.

To explain the term "unmodulated signals" it would be easier to give a brief explanation of modulation.

Modulation is the process of superimposing an intelligence on a signal of a certain frequency, which is being broadcast by a transmitter. The steady carrier wave is made to vary, either in frequency or amplitude depending on the system of modulation used, in sympathy with the modulation source.

The absence of modulation would obviously produce only a steady carrier of some fixed frequency, which is therefore referred to as an unmodulated signal.

The words "high frequency circuits" are not so much a recognised term as a phrase which appears fairly frequently in radio literature. Its meaning is likely to vary with context.

HF CIRCUITS

The most common usage is in relation to receivers where "high frequency circuits" would refer to those carrying radio frequency or intermediate frequency signals, as distinct from the audio and power supply system.

Very rarely, with the discussion centring on tuning systems, etc., "high frequency circuits" might be used to describe short-wave coils, circuits and switches, as distinct from the broadcast band units.

In an article on audio amplifiers, speaker systems, and so on, "high frequency circuits" might describe units handling the treble end of the spectrum, as distinct from those handling the middle and bass register.

The term "potentiometer" usually refers to a potential divider performing the function of a volume or gain control. It consists of a resistor which is effectively subdivided by a sliding contact. Placed across a source of potential difference, it allows smaller potentials to be picked off between one end and the sliding contact.

The letters EHT, Tom, are an abbreviation for "extra high tension." They refer to the very high voltage (usually between 1,000 and 20,000) applied to the high voltage electrodes in a cathode-ray tube.

Use of the term EHT avoids confusion with the normal HT (high tension) or B-plus voltage present in oscilloscopes, television receivers and other such items.

"Tag terminal strips" are strips of bakelite equipped with terminating lugs. They are used to support minor components and wiring when a number of these are to meet at a single junction point. The use of mounting strips results in shorter leads and neater wiring layouts.

* * *

Two other points which have aroused my curiosity were a mention of a "grid bias circuit" and "feedback." Would you explain these?

The term grid bias refers to the negative D.C. potential which is applied to the grid in order to make this electrode negative with respect to the cathode.

The incoming signal adds to or
tracts from the fixed bias and c
variations in the electron flow fror
cathode to the anode. These vari
of electron flow or plate current a
across the plate load as larger si
thus achieving amplification.

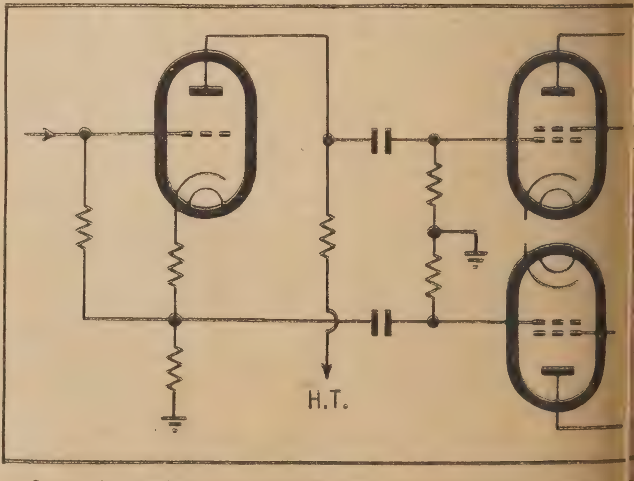
There are several ways in whi
steady potential may be applied t
grid of a valve. A bias battery m
inserted between the grid leak and
the positive side of the battery
earthed. The cathode is then ret
to earth and the potential differenc
tween the grid and the cathode w
that of the battery voltage.

BIAS BATTERIES

Bias batteries are bulky and i
venient to use and the standard pr
is to use a cathode bias circuit. I
arrangement use is made of the ca
current, which is a combination o
screen and plate currents. A resis
placed in the cathode return to ear
that the current flowing through it c
a voltage drop across it. This place
cathode effectively above earth by
voltage developed across the resisto

If the grid is returned to earth,
the cathode will be that many
above or positive with respect to
grid, which is at earth potential.

Making the cathode positive wit
spect to the grid is equivalent to pi



Circuit of a standard "plate-cathode" phase changer discussed in answer to
this month.

cation data for the 12BY7, has
fairly adequate in practice. Its
n be augmented in special cases
further trap in the plate circuit
may have more to say about
later date.
athode circuit to earth is com-
hrough the 500 ohm Contrast
potentiometer which is now
, for convenience, on the front
the chassis.
a word about the cathode wir-
nce the circuit is "hot" and car-
quencies up to at least 5.5 Mc,
ons must be taken against pos-
diation, earth loop effects and
instability. Also, cathode-earth
nce will give some useful high
cy video boost with resistance in
out only if the capacitance is of
t order.

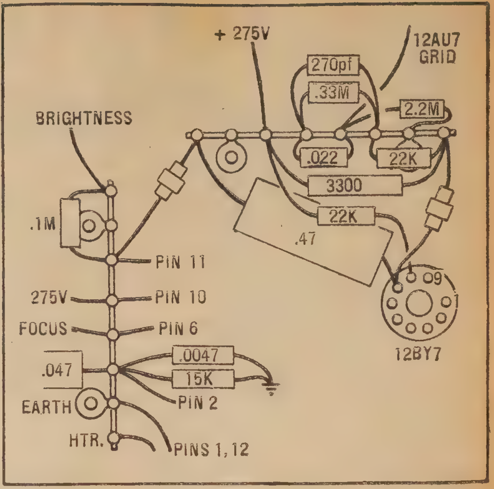
ODE LEAD

these things in mind, the lead
e trap coil to the potentiometer
be run in small diameter coaxial
ble. Earth the braiding near the
socket and use it as the sole
turn for the potentiometer.
last is shown in our photographs
dem type and is, in fact, a double
hm type with the elements wired
lel to give an effective 500 ohms
ple current carrying capacity.
alternative to this type, a wire-
pot can be used, as far as we
cover without any ill effects.
element carbon types, particu-
all types are not recommended
position. While current through
ment is quite low in normal use,
se to damaging proportions when
trol is advanced towards mini-
esistance with very weak signal

mentioned last month, the grid
to the last lug on the adjacent
and thence to the video output
in the IF strip The lead should
clear of the chassis, to minimise
nce, and the pigtails on the re-
which picks up AGC on the tag-
ust mentioned, should be kept
or the same reason.

N BYPASS

that the screen bypass is now
returned to the cathode circuit
than to earth, as a precaution
instability in the video amplifier.
bility may show up as a random
se pattern on the screen or, if it
to occur at a much higher fre-
its most evident effect is to re-
he action of the Contrast Con-
The picture contrast is seen to
in the normal way as the con-
turned towards minimum resist-
ut the action then reverses, the
diminishing to a low order at
sistance.
e unlikely event of this trouble
ing evident, when the receiver
d, the screen bypass can be wired
back to cathode instead of to the
of the trap coil.
e original set the screen bypass
d in place against the rear corner
chassis by a loop of wire, the
or leads running away to the
riate points.
ponents and wiring which feed
put of the video amplifier to the
tube and to the synch separator



Components to do with the video output circuit can be grouped logically as shown on two 8-tag strips. The strip at the top segregates the signal for the synch. separator, while the strip on the left provides a termination for the cabled leads running to the picture tube socket. Note that the picture tube cathode lead must be kept separate from the others

terminate on two eight-tag strips, which are mounted adjacent to the 12BY7 socket, as shown in the accompanying sketch.

There is plenty of point in following this layout, because it is logical and orderly to begin with and, furthermore, the peaking components assume orders of capacitance which the layout gives. A further and no less important point is that it keeps high level video voltages away from points in the synch separator circuit, other than the input grid itself.

In actual fact, of course, components can be kept even closer to the tagstrip than can be depicted in a simple plan sketch.

Note also that the 0.47 mfd coupling capacitor is deliberately swung clear of the chassis and not tucked down against it and among other components. Stray capacitance to earth is thus once again kept to a minimum.

As indicated, all leads to do with the picture tube terminate on one tagstrip and then pass up through a grommetted hole to the picture tube socket. The external lead to the socket will need to be a trifle more than 12 inches long. All wires can be plaited for neatness except the cathode wire, which passes through a separate hole and is kept clear of the others to minimise capacitance loss.

WIRING DIAGRAM

Interconnection of the tagstrips and relevant components to the remainder of the wiring should be clear enough from the main circuit diagram.

Mounting holes for the tagstrips are already drilled in the chassis, though, in the one we used they had to be extended a little with a file to straighten the strips and make them fit as intended.

If you have a CRO on hand, operation of the video amplifier can be observed at this stage by setting the CRO time base to about 16, 25 or 50 cps and clipping the vertical amplifier input lead to the cathode end of the 0.47 mfd. coupling capacitor.

By suitably manipulating the CRO controls and the receiver tuning it should be possible to see the video content in one or more frames, changing with movement in the picture and with the frame synch area fairly sharply defined.

Amplitude of the pattern should vary with the setting of the contrast control.

From the video amplifier, portion of the signal is diverted to the 12AU7 synch separator stage and this can logically be wired next.

As already mentioned, the components to do with the separator input circuit are mounted on the tagstrip adjacent to the 12BY7, leaving only a simple lead to run to pin 2 of the 12AU7. Keep this lead reasonably clear of the other components and also away from pin 1, so that video energy shall not be coupled directly into the second stage instead of via the first triode.

WATCH LAYOUT

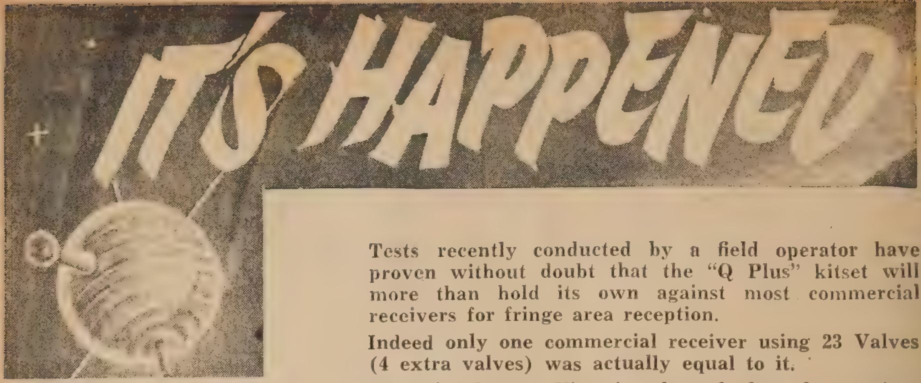
The remainder of the components have to be disposed between the synch separator and the two oscillators which the synch pulses are intended to control.

While there may be many possible ways to arrange the components the layout is important to the extent that unwise placement may change the intended proportion of line/frame/video signals or, by grossly increasing the bulk of the circuitry, make it liable to pick up line energy from the deflection output circuit.

With this in mind, we suggest that you follow the method shown in the accompanying diagram. It involves mounting an 8-tag and a 7-tag strip in the space between the separator socket and the two oscillators. The chassis you buy may have the necessary mounting holes already punched, but drilling an extra small hole is no great chore.

The 8-tag strip supports most of the synch. separator components, while the 7-tag strip carries mainly the synch. input and timing components for the frame oscillator.

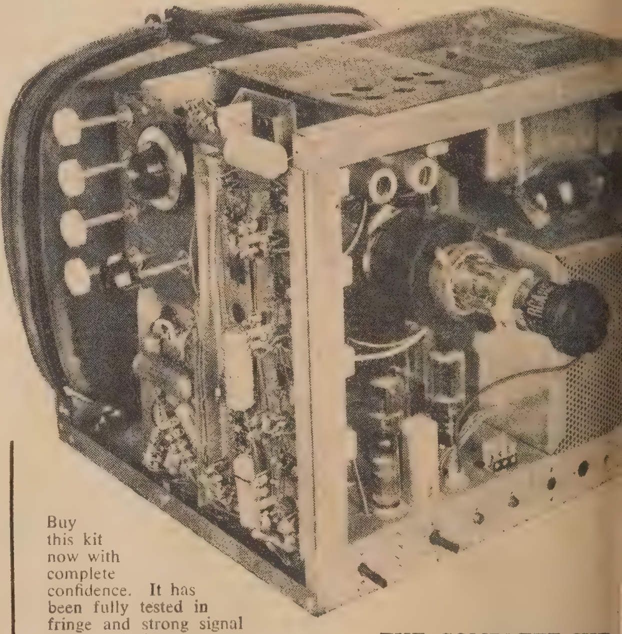
For neatness, it is almost essential to use small resistors and capacitors, but, once again, do not use "high-K" capacitors. These are intended primarily for



Tests recently conducted by a field operator have proven without doubt that the "Q Plus" kitset will more than hold its own against most commercial receivers for fringe area reception.

Indeed only one commercial receiver using 23 Valves (4 extra valves) was actually equal to it.

Tests in Cowes, Victoria, showed that the receiver operated even with a short length of ribbon shorted at the ends!



Circuit function and valve types

Power Supply (5AS4)

Primary taps for 200, 220 and 230 v. operation, desired tap selected by special plug and socket, mounted on power supply chassis, full wave rectification with capacitative input filter, giving low ripple content. A 300 mA fuse is incorporated. Mains transformer has copper shield for minimum external field.

Tuner (6BQ7A, 6U8)

Q Plus type VTT/1 10 channel turret tuner featuring low noise "Cascode," R.F. amplifier and high-mu mixer oscillator. Low impedance output to I.F. channel. Special moulded coil formers threaded throughout their entire length prevent cores from coming loose. Special "alkyd" low loss high stability plastic used on all coil biscuits and mouldings. Oscillator is compensated for frequency drift due to variations in temperatures. This unit comes fully tested and pre-aligned.

Video and Sound I.F. Channel (4-6CB6, 2-6AL5, 1-6AU6)

The ever popular Mark III I.F. strip, four stages of video amplification using bifilar and an over-coupled stage, low impedance input to match VTT/1 tuner. Video detector, with R.F. filter and video detector load, intercarrier taken from video detector. Sound amplifier/limiter stage and ratio detector, fully tested and aligned.

Audio Amplifier and Output (6AV6, 6AQ5)

A triode voltage amplifier with beam tetrode power output. Negative feedback is applied to the 6AQ5. The required F.M. de-emphasis is obtained by a simple R/C network at the input to the volume control. Frequency response 90 C/s—5Kc/s at—6db.

Video Amplifier (12BY7)

A high gain pentode using a combination of series and shunt peaking. Video detector is directly coupled to video amplifier grid. Output is capacitatively coupled to picture tube cathode. The gain (contrast) is controlled by a cathode potentiometer. Frequency response up to 4 Mc/s at -6db., and greater than -40 db., at 5.5 Mc/s.

Sync Separator, Sync Phase Inverter (12AU7)

Sync pulses are obtained from the output of the video amplifier and applied to the sync clipper which removes most of the video content, and provides a substantial degree of noise immunity. The sync phase inverter further separates the sync pulses from the video, and also reverses the phase suitable for triggering the line and frame oscillators.

Frame Oscillator and Frame Output (6CM7)

A frame blocking oscillator is used. The frame output stage drives the deflection using an autotransformer to match the output to the yoke impedance.

Line A.F. Line Blocking Oscillator or 6SN7GTA

The line A.F.C. is a D.C. control valve to correct the line blocking oscillator which used a "sine wave" stabilising coil. Small changes in sync control are obtainable by a pot. control on the D.C. control valve. Once aligned correctly, this circuit will remain in sync, over long periods, with varying signal strength and mains variation.

Line Output, E.H.T. Supply (6DQ6A, 1B-3GT, 6AX4-GT)

The line output/E.H.T. transformer (Q Plus VHOPT/1) (auto-transformer type) and the E.H.T. rectifier are shielded in a metal case and cover, supplies 15 KV picture tube ultor on load. Provision is made to alter this section for higher ultor voltage and drive suitable for a 90 deg 21in picture tube. Picture tube (17AVP4A) 90 deg magnetic deflection, electrostatic focus.

A.G.C.

"Simple" type A.G.C. voltage is developed by separate rectifier has an A.G.C. clamp.

Chassis

The main chassis comes pre-assembled, ready to take the power supply, line output/E.H.T. cage, tuner, video and sound I.F. channel, frame oscillator and output sub-chassis. The picture tube mounting, strap etc. are screwed to the main chassis, making it one complete unit.

Controls

Channel selector and fine tuning are a dual concentric knob, volume off-on, brightness, contrast, frame hold, line hold, controls are grouped together and fitted with smaller knobs. Frame height, frame linearity, line drive, line oscillator, line sine wave, controls are mounted on the rear of the main chassis. All these controls can be adjusted without removing the back of the cabinet.

General

The speaker (5in) is mounted on the left hand side of the cabinet and mounted onto the cabinet. 9ft of 3-core P.V.C. sheathed power flex extends from the rear of the cabinet.

Buy this kit now with complete confidence. It has been fully tested in fringe and strong signal areas with full A1 performance

If you have any doubt, we will send you the 18 page construction manual, giving fully detailed photographs, circuit, component, voltage and waveform data, and assembly instructions for only 11/6 post free (also available from kitset dealers).

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but less cabinet.

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functions and, because their
nce can be much higher than the
value, they can cause mal
ing in separation and timing
where time constants are sig-

ng completed the wiring of the
separator stage, the waveforms
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step is to wire the 6CM7 frame
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ing to detail this, some explana-
necessary in regard to certain key
ents in both the frame and line
n circuits.

E OSCILLATOR

rame oscillator is of the blocking
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a blocking oscillator transformer
just the right characteristics.
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into a suitably designed output
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line output valve must also be
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eflected. Two other minor com-
the line Width and Linearity
ust also have the intended effect.
but not least, as a by-product
peration, the line output system
upply an adequate voltage and
from its B-plus boost circuit to
he frame oscillator and output.
ss all these components "mate
," the circuit will not work cor-
f at all.
is receiver, as in the previous
we have adopted the very simple
of using A.W.A. oscillator and
n components, distributed by
cturers' Special Products and
d by most radio trade houses.

BLE SUBSTITUTES

ng the past few months, how-
e have seen electrical duplicates
t of these components, manufac-
y other reputable firms. While,
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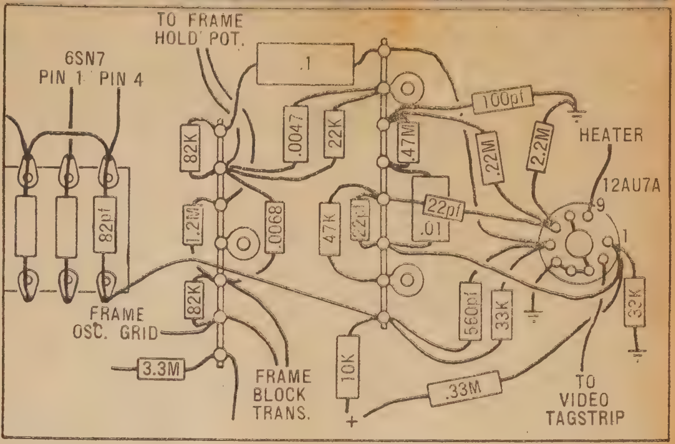
y should be equally suitable for
sent receiver.
**vital point to watch is that you
pplied with components which
pressly designed for use in the
and H. circuit and intended for
ree deflection. Do not try to
do with others, just because they
to be called by the same name.
may be excellent in other cir-
ut quite unsuitable for this one.**
ng now to the 6CM7 frame oscil-
nd output stage, you will need
valve a good quality moulded
fitted with a valve shield. This

WIRING OF THE SYNCH SEPARATOR



Components around the synch. separator can easily become a contused mass unless mounted and wired systematically. We suggest you arrange them this way, those on the 7-tag strip leading logically into the frame oscillator. Note also the line pulse feed to the nearest lug on the line oscillator panel.

is a precautionary measure against possible penetration of line deflection energy into the frame oscillator. with disturbing effects on the interlace.

The socket should be mounted with pins 1 and 9 towards the IF strip and care taken, when wiring, to see that it is not contaminated with excess flux. As indicated on the circuit. the output plate operates with something like 500 applied volts and a pulse amplitude of about 1,000 volts peak to peak

The frame blocking transformer and the frame output transformer mount above the chassis in the positions shown in last month's general photograph, the leads passing down through grommetted holes in the chassis.

FRAME WIRING

In wiring the frame circuitry, the only component in our layout which attaches to the 6CM7 socket is a 3.3M resistor, which bridges from pin 6 to the end lug on the 7-tag strip mentioned earlier It is shown clearly in the synch. separator wiring diagram.

All other components to do with the frame oscillator and output stage are mounted on the panel near the rear edge of the receiver and set away from the chassis, on pillars or long bolts. by not less than 1 1-8 inch.

This board is often supplied in lengths containing 24 lugs per side. A 15-lug section can be cut for the frame panel. leaving a 9-lug section to be used later for the line oscillator components.

Actually, if last month's instructions were followed, this panel will already be in place, with the end lugs used to terminate the mains input circuitry.

Wiring to the remaining lugs is shown in the accompanying layout sketch and. for the most part, follows our earlier 21-inch receiver. However, lugs serving the EHT cage are wired somewhat differently.

One of these lugs is connected to earth, one to the 6.3 volt heater wiring, one to the B-plus line, while the other receives the boosted HT voltage from the cage for subsequent filtering. Four leads passing down through the chassis from the cage can be attached very simply to these lugs, the only other subchassis cage lead being the one carrying sawtooth drive voltage to it from the line oscillator.

The "safety link" wiring, hitherto accommodated on the resistor panel, is now in the cage itself, so that three lugs are now unused. Note the position for the 6,000-ohm boost filter resistor and the 16mfd capacitor, the latter being tucked between the panel board and the chassis.

The suggested spacing of the board should allow the capacitor to be fitted in comfortably but make sure that it is not placed in a position where a heated solder lug could puncture its outer sleeving. The negative end of the capacitor now returns to pin 9 of the 6CM7, not to earth as formerly.

Interconnection of the remaining lugs and components to the rest of the wiring should be readily discernible by comparison with the main schematic circuit.

The frame oscillator and output stage cannot be tested under actual working conditions at this stage, because both sections are intended to operate from about 500 volts, supplied from the not-yet-completed E.H.T. cage. In any case. it is unwise to operate either the frame or the line output stage without proper connection to the deflection yoke, which provides their output load.

PRELIMINARY TEST

However, neglecting actual amplitude. the frame oscillator can normally be made to work, if supplied temporarily from plus 275 volts, and the waveform and locking observed on any ordinary oscilloscope.

The frame output transformer, incidentally, is mounted above the chassis and the red (or brown) and yellow leads terminate on adjacent lugs, as indicated, at one end of the panel.

From these same lugs a twisted pair of leads run to a socket and plug, mak-

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Comb. Video IF and Soundstrip
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103	Second video. 6BX6 .. .	14/-
104	Third video. 6BX6 .. .	14/-
105	Fourth video, 6BX6 .. .	14/-
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80	2-5v 1.75 amp. 6 kv ins	26/8
61	4v 1 amp. 5 kv ins.	26/8
62	6.3v 6 amp. 5 kv ins.	26/8
63	Frame output trans. 6BM8	33/4
220	EHT supply 3000v Osc. coil	26/8
77	3h. 300mA	20/-
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534	Coil dope and core sealing lacquer	3/-

Coil Former ¾" square can with two cores

Part No		
506	4-pin coil assembly	4/8
507	4-lug coil assembly inc. 2—47 pf.	7/4
508	5-lug ratio assembly, inc. 1—22pf and 1—47pf	7/4

Video and RF chokes filament and filter chokes

Part No.		
408	Aer. RF choke. C.T. 2uh	3/4
409	2uh filament choke	3/4
410	15uh video choke	3/4
411	47uh video choke	3/4
412	150uh video choke	3/4
413	330uh video choke	3/4
414	TV noise filter, 2 amp ..	3/4
415	3uh damper diode choke	3/4

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COPY OF REPORT RECEIVED FROM THE ELECTRONICS DIVISION OF SYDNEY'S MAIN TV MANUFACTURER

10th February, 1958.

MR. BELL,
R.C.S. Radio Pty Ltd.,
651 Forest Rd.,
BEXLEY, N.S.W.

Dear Mr. Bell,

Referring to the R.C.S. Combined video and sound strip No. 557 submitted to us for examination and comment, we found the strip performed very well indeed.

When a Philips tuner was connected to it the IF primary (on the tuner) was adjusted to 32.5Mc/s for a good pass band. The amplifier kept its pass band shape under varying conditions of bias and signal strength, which is a clear indication of the absence of feed back effects. No evidence of overload was present even under strong local signal conditions (approx. 250mV from Channel 9). Coupled into a receiver the picture quality was good. The pass band of the strip was substantially flat with a band width of 4.5 Mc/s between the 6dB points. This compares well with the best commercial receivers.

With threevolts bias on the A.G.C. line the IF strip showed a mid-band sensitivity of 2mV at the first IF grid for 1 volt DC at the vision diode. With no bias on the A.G.C. line the sensitivity was approximately 40uV and the amplifier quite stable.

Built according to the sample described the strip could be used to build a receiver of the highest standard of performance to compare favourably with any commercial receiver on the market

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nnection with the vertical scan n the yoke.

ur earlier receivers, these frame passed out through a separate etted hole near the frame trans-, attaching to a socket which more floated in mid-air between the and the yoke.

his receiver, the frame leads run eath the chassis and up through ge to a socket which is attached underside of the cage cover. The ntal deflection leads also terminate socket, as also do two leads from the cage, providing the B-plus link."

e appears to be no electrical ob- to this scheme and it does elim-oose wires on top of the chassis. ke lead simply plugs into a mating in the top of the EHT cage.

final major section to be installed red in the main chassis is the line or and control circuit, using a GTA (or "B").

LLATOR COIL

the elimination of the angle from the centre of the chassis, e oscillator blocking coil is now d alongside the sine wave coil out 1 3-8 inches away from it. chassis does not have a suitable ready punched, one will have to ed to the exact size of the exist-e for the sine wave coil.

holes must be accurate, to suit ent push-fit clips used for both Mount the sine-wave coil nearer ver transformer and the blocking or coil in the remaining hole. In shed receiver, the cores of both dily accessible from above the for final adjustment.

6SN7 socket should be mounted e keyway pointing in the general n of the audio amplifier, so as to ins 1 and 2 adjacent to the oscil-il.

e or four components to do with e oscillator are soldered to the and coils but the rest mount on inal panel having nine lugs per s mentioned earlier. Provision be made to mount this in the shown, about 1 1-8 inch from ssis but it can well be wired up actually being secured in posi-

IG DETAILS

rring to the circuit, the 68K resis-ches directly to the Line Hold .01 capacitor bridges across the ave coil, a 68K resistor across the line oscillator coil and a capacitor swings between the os- coil and pin 1 of the 6SN7

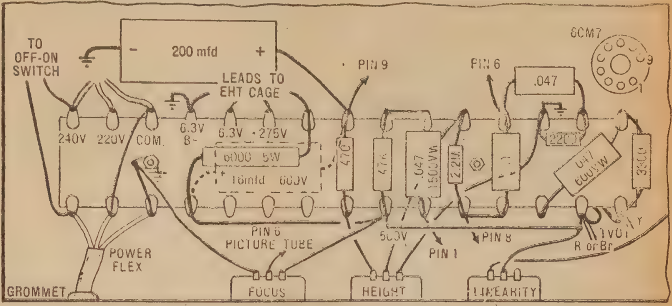
ine wave coil has two connections d polarity is not important. How-ere are three connections for the or coil and manufacturers' data e "start" or inside of the winding ed to plate, "finish" to the grid or, with a tapping marked by a spot. Make sure you get it the ay round.

e absence of a drawing of the arrying the line oscillator com-, it will be necessary to describe ing of it in so many words. It tricky and it may be helpful ch it out roughly for yourself to e the risk of error.

the sake of identification, we efer to the two lugs nearest the 6SN7 socket as number 1 pair, progressing through 2, 3, 4 and so on to the other end.

The capacitor between the number 1 pair of lugs is the 82pF mica or ceramic, which feeds the line pulse from the synch. separator to pin 4 of the 6SN7 grid. The connections to it are obvious from the main circuit.

The 0.15M line oscillator grid resistor mounts between the number 2 pair, the lug nearer the 6SN7 socket being connected directly across to pin 1.



This diagram shows the arrangement of components on the panel serving the frame oscillator and output stage. Leads run to the yoke from the two lugs at the bottom right. They can be twisted for neatness but must be color coded so that they connect to the correct pins on the yoke plug.

Between the number 3 lugs is the 0.33M input grid resistor, the lug nearer the socket being connected under the panel to the appropriate lug 1 and thence to pin 4 on the 6SN7 socket as already mentioned. The other end connects to the 0.1 mfd. capacitor, running across to the number 4 lug, nearer the socket, and thence to the valve cathode pin 6.

From this same point, an 82K resistor bridges to lug 4 furthest from the 6SN7 socket, an 0.82M resistor running from here to the adjacent lug 3 to complete this portion of the circuit.

ORIGINAL PHOTOS

ORIGINAL, unlabelled, glossy photos from which the blocks in these pages were made are available through our query service at the following prices:

8 x 6 inches (each)	5/-
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When ordering, state clearly which photographs are required.

Another 0.33M resistor mounts between the number 5 pair of lugs, the one nearer the socket being earthed. The .02 mfd cathode bypass can thus bridge directly between this earthed lug and the adjacent lug 4. The circuit to the other end of the 0.33M resistor is completed by linking it to the adjacent lug 4 and also to lug 2 on the same side of the panel.

An 0.47 or 0.5mfd capacitor is supported across the number 6 pair of lugs, a 3900 ohm resistor running from the one farthest from the socket back to the earthed number 5 lug just mentioned. The other end of the capacitor must be linked to lug 4 and thence to the 6SN7 cathode, pin 6.

The number 7 lugs and the number 8 lugs carry respectively an 82pF capacitor and a 68K resistor. One end of the resistor bridges across to the sine wave coil, the other end being connected to the B-plus line.

The 0.15M resistor and 15pF capacitor in the feedback line bridge between the end of the 68K connecting to the sine wave coil and the remote end of the 82pF capacitor just mentioned. The remaining end of this capacitor must be connected to the appropriate lug 1 on the panel and thence to the grid pin 4.

Purpose of the line oscillator is to supply a sawtooth drive voltage, locked with the transmitter line frequency, to the line output stage. The active signal lead runs from the junction of the 68K resistor and sine wave coil, through the nearby grommetted hole, into the EHT cage above.

The drive voltage is developed principally across a .001 mfd. capacitor running to the cathode of the line output valve. This serves both as a timing capacitor and an RF bypass and the line oscillator circuit will not work reliably without it.

TESTING LINE OSC.

The capacitor in question is mounted in the EHT cage and, to test the line oscillator without the cage in position, it is essential to bypass to earth temporarily the junction of the 68K resistor and the sine wave coil, using a .001 capacitor.

As indicated in the circuit and photographs all components to do with the line output stage and the EHT supply are housed in a metal cage above the chassis, a method which serves very well to confine the energy associated with the line deflection system.

The EHT cage can be built as an entirely separate unit, connecting into circuit by a few simple leads passing down beneath the main chassis. The terminal points for these leads have been indicated earlier.

All components in the EHT cage are assembled on to a base plate measuring approximately 5 x 5 inches, with a half-inch flange upturned to support the top cover. This latter should be a tight push-fit but is intended to be held in place by three or four self-tapping screws.

The box you buy may be specially designed for the 90-degree components or it may have been drilled according to an earlier blueprint, intended for the original 70-degree components. In this latter case, one or two new small holes

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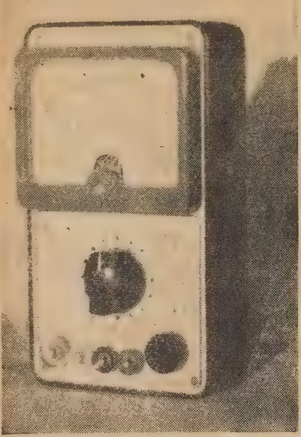

TESTER BOY MULTIMETER

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Dimensions are 6 inches high, 2 3-8 inches wide, and 2 5-8 inches deep.

Weight, 1lb 13oz.

Ranges as follow:—

Volts, AC and DC 2.5, 10, 50, 250, 500, 5000.

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Decibels, minus 20db to plus 10db.
0db to plus 22db.
By referring to a chart up to plus 56db. may be measured.

The case is black bakelite with a metal panel and 3-inch meter. Test leads are provided and also a leather carrying case that holds meter and leads. Sensitivity of meter is 1000 ohms per volt.

Price of this unit is

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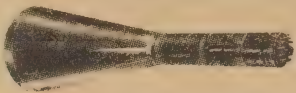

CATHODE RAY TUBES AND RADIO VALVES

Type VCR 138 3½in diameter cathode ray tube. Idea, for oscilloscopes, etc.

Characteristics:
- Filament Volts 4.
- Filament Current 1 amp.
- Anode 2-200 volts.
- Grid 1-50 volts.
- X plate sensitivity .14.
- Y plate sensitivity .33.
- Anode 3-1,200 volts.
- Electro-static deflection.
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Socket connections can be supplied to each purchaser. **Price 25/ each.**

Type 902 2in Cathode Ray Tubes, ideal for instruments, etc. Brand new and boxed. Well-known make, **47/6 each.**

Type 815 Push Pull RF Beam Power Amplifier. Used as class AB2. A.F. power amplifier and modulator. Max. output: 75 watts. Class C Telegraphy max. output 75 volts. Class C Telephony max. output 60 volts. Filament volts 12.6 or 6.3.

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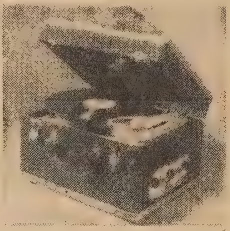

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.005	2500	Block	2/
.01	2000	Mica	2/
.01	5000	Block	4/
.01 + .01	2000	Block	3/
.01 = .001 + .005	600	Block	1/
.02	1000	Mica	2/
.025	2000	Mica	3/
.1	500	Block	1/
.1	1500	Block	2/
.25	3000	Block	3/
.5	750	Block	2/
1	400	Block	2/
2	400	Block	3/
4	750	Block	6/
5	400	Block	4/
3 + 5	400	Block	7/

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need to be drilled or existing elongated with a small file, to everything fit in properly.

siderable care is necessary in ning the line output transformer. ds to be pushed along as far as e in one direction to clear the ty and Width coils but, at the time, the circumference of the winding must be kept well away he cover, so as to minimise the corona discharge.

gs will fit into position much if the mounting foot of the line transformer is reduced to ¼-inch on the side opposite the terminal Be very careful in doing this, e any crack or chip in the insu- of the EHT coil will encourage effects.

FIER SOCKET

re finalising the position of the rmer, however, the skirted socket e EHT rectifier should be con- . It needs to be mounted on 5/8-inch above the baseplate oles should be elongated, if not correct, to bring the socket ver against the side of the cage.

line output transformer should e slipped in alongside it, with the oil fitting into the existing cutout bakelite flange. This cutout can rged somewhat with a round file, extended slightly into the vertical , to allow the EHT coil to come gainst the socket and as far as e from the side of the cage.

ng thus determined a position for e output transformer, leaving as learance as possible for the Line- nd Width coils, drill the necessary o it can be mounted temporarily tion.

ndicated in the photographs, the ty coil pushes into the top hole vertical bracket, the Width coil below it and set to one side to he filament loop supplying the ctifier. The position of these coils be checked, without actually lock- m in place.

position for the horizontal drive or can likewise be checked and, bracket does not clear the line transformer, a couple of new an be drilled, setting the capacitor further back but still in line he screwdriver hole in the rear .

drive capacitor can most easily dered to the supporting bracket efore it is finally mounted in , make sure that it will spring to the fully open position, when ew is turned anti-clockwise.

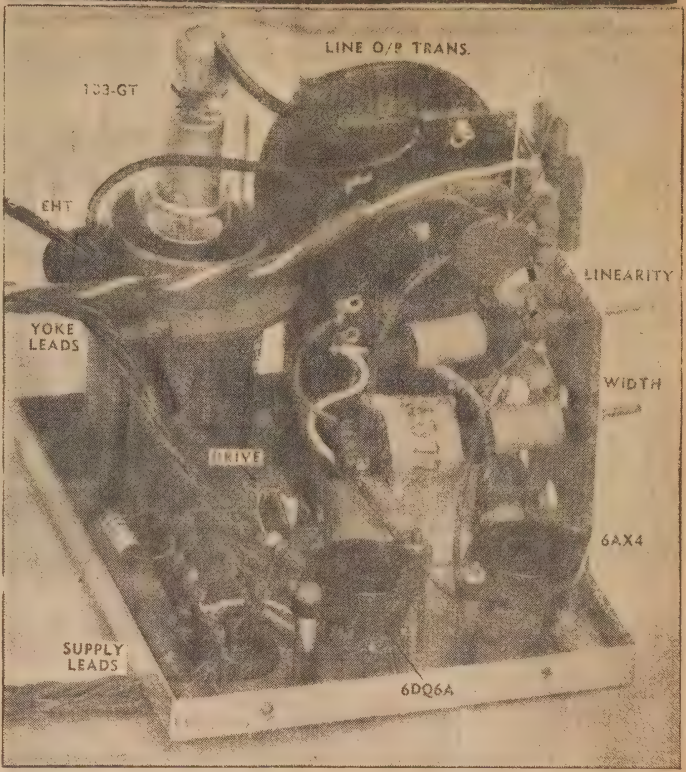
R VALVES

the line output and damper diode ordinary moulded bakelite sockets ffice, though they must not be inated with flux. You will need ide pillars or long bolts, so that n be mounted about 1 inch above e plate.

other point needs to be specially d at this stage. As mentioned the new design provides for the ocket to attach to the inside top cage cover. All wires come to within the cage, except for two output leads, which merely run ough the cage from beneath the

ot already provided, we suggest that you punch or file two octal-sized valve holes in the top of the cover. One is merely a clearance hole to allow the EHT lead and its shrouded connector to pass through. A scrap of split plastic tubing can usefully be cemented around the edge to prevent chafing and possible arcing.

COMPONENT LAYOUT — EHT CAGE



A detail view of the EHT cage, with the 6DQ6A and 6AX4 valves removed. Most of the components relevant to the 6DQ6A are on the tagstrip in the foreground, those to do with the Width and Linearity circuits on the tagstrip on the line output transformer panel.

The second should have small holes drilled to suit the mounting centres in a standard moulded socket.

Two simple methods suggest themselves for securing the socket. If it has a metal flange, two nuts can be soldered to the underside, allowing screws to be tightened from the top. With an all-bakelite socket, screws can be passed through the holes in the socket, pointing upwards, and each locked with a nut. After passing through the cage cover, a second nut on each will secure the socket in place.

The intention is that wires should connect to the socket from within the cage, no longer than strictly necessary, so that they will not lie against hot valves etc. If need be, the receiver can be operated with the EHT components exposed. Alternatively, it is a simple matter to slip the cover over the base plate, manipulate the socket into position and secure everything in place, without undoing any soldered joints.

Having thus made sure that all the major items can be installed without further complication, the smaller items can be fitted and wired.

12BY7 SCREEN RESISTOR

Due to a mechanical fault, the value for the 12BY7 screen resistor did not print in the main circuit diagram. It should read 22K, 1W.

8-TAG STRIP

Most of the components serving the 6DQ6 line output valve are carried on an 8-tag strip near the front of the cage. This can be seen in the photograph and the arrangement of components is illustrated by the accompanying sketch.

A trailing lead, passing through the base plate, terminates on the lug marked "Drive." This ultimately connects, underneath the main chassis, to the active end of the 68K resistor, mentioned earlier, supplying the line oscillator plate circuit.

Another trailing lead, picking up 275 volts from beneath the main chassis, terminates on an otherwise blank lug, all B-plus leads from within the cage returning to the adjacent lug as shown. The circuit between the two is completed via a short twisted pair, con-

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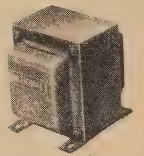
	470,000 ohms ½W	BTS	4
	3,900 ohms ½W	BTS	1
	2,200 ohms ½W	BTS	1
	100 ohms ½W	BTS	1
	1.5 meg ½W	BTS	2
	10,000 ohms ½W	BTS	3
	82,000 ohms ½W	BTS	1
	3,300 ohms ½W	BTS	1
	1 meg 1W	BTA	1
	100,000 ohms 1W	BTA	3
	47,000 ohms 1W	BTA	2
	220,000 ohms 1W	BTA	1
W.W RESISTORS	I.R.C.	TYPE	
	5 Watt Wire Wound		
	1000 ohm Ctg "A"	AB	1
	50 ohm 5 Watt Ctg "A" (Centre Tapped)	AB	1
	125 ohm 20 Watt Ctg "B"	DG	1
VOLUME CONTROL	I.R.C.	TYPE	
	0.5 Meg. Single Carbon Control Standard (Silent Spiral)	CS	3

COMPONENT	SPECIFICATION	TYPE
TRANSFORMER 	NATIONAL	TYPE
	325V—325V	PA180/325
	6.3V 4A	
	6.3V 4A	
	5V 2A	
VALVE SOCKETS	TELETRON	TYPE
	Octal with mtg saddle	ST48L
	9-Pin with shield	ST59G/2
	9-Pin less shield	ST29G
STRIPS	TELETRON	TYPE
	4 Tag	SM24
	8 Tag	SM28
CAPACITATORS	A.E.E.	TYPE
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	.047 mfd 400 Volts	W48
	022 mfd 200 Volts	W99

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g to the yoke socket on top of
ge and the "safety" link in the
plug.
his stage, the drive capacitor can
ounted permanently in position,
he sockets for the 6DQ6A and
and the relevant wiring com-

heater wires from the sockets
twisted together with the B-plus
nd another for the B-plus boost
for ultimate connection beneath
ain chassis. By using separate
for the heater wires and ground-
e to the cage baseplate, it can
oth as a heater lead and as an
eturn for the HT circuits.

TT RESISTORS

that the 68 and 8200 ohm re-
are specified as 2 watt and, if
mediately available, can be made
m pairs of 1-watt resistors in
, each approximately double the
d value.

components to do with the B-
oost circuit are mounted on an
trip, with one lug trimmed off
it will fit between the feet of
e output transformer. This strip
seen in the second of the cage
raphs and the suggested con-
s are shown in the accompany-
all diagram.

third tagstrip illustrated is a four
e and carries the remaining com-
, associated with the damping
e output circuits. By drilling a
arefully in the bakelite terminal
of the line output transformer,
nponents, so mounted, are readily
le and the outgoing yoke leads
aight up to the socket.

e the tagstrip can well be bolted
ace, there is not much point in
until the line output transformer
een mounted permanently in
.

lling the line output transformer
T socket calls for some careful
because the ends of the rather
ire loop supplying the rectifier
t have to pass up under the
to the pins, without straining or
g the insulation or coming too
the metalwork.

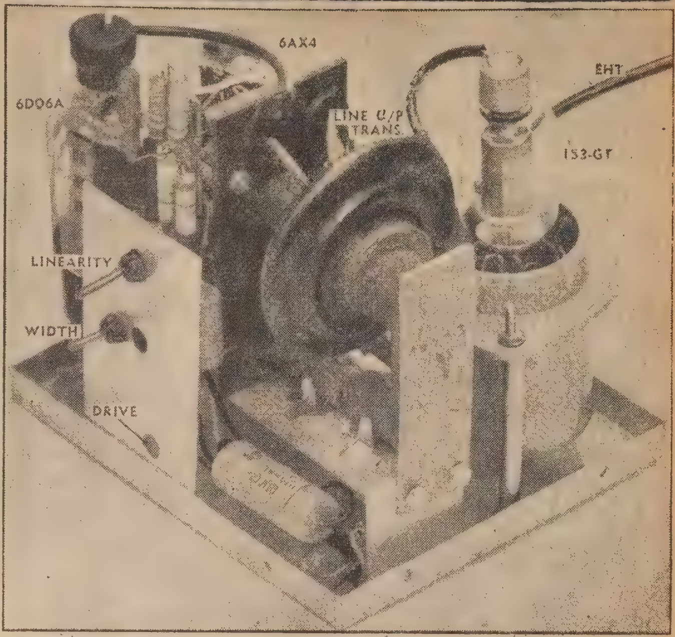
E SOCKET

small resistors also have to be
up inside the skirted socket,
o be as remote as possible from
eplate. Miniature resistors should
so that they can bridge between
pins and be pushed in close
le them. The 1.5 ohm resistor
nect between pins 6 and 7, while
0 ohm resistor can run between
4, this last becoming the take-off
r the EHT lead.

ng placed the resistors, our sug-
is to drill three small holes in
ted-base, about ¼-inch from the
, on the side facing the trans-
and in a position such that the
ment leads can run conveniently
the holes to the appropriate
e EHT lead passing out through
d hole.

k the position of everything by
the transformer and socket in
n the baseplate and noting the
positions. They can then be
upside down in the same relative
, the filament leads trimmed,
through the holes and soldered.
leads are available nowadays
shrouded connector ready to clip

ANOTHER VIEW OF EHT CAGE



This second view of the EHT cage, taken from the opposite corner, shows the line output transformer in the foreground with the tagstrip carrying the B-plus boost components below it. With care, every component in the cage is accessible for service.

into the Ultor of the picture tube. Slip a small grommet over the lead to help hold it in position later, inside the cage, pass it through the hole in the socket and solder to the appropriate base pin.

If, for any reason, you cannot obtain a proper EHT lead, ordinary plastic hook-up passed through a length of plastic tubing will suffice. Alternatively, the braiding can be stripped off a length of small diameter coax cable and the outer sheath replaced, to give a doubly insulated inner conductor.

A spring clip for the Ultor connection can be manufactured from a safety pin but exposed connectors are always prone to some ionisation or leakage, particularly when dust begins to collect on the glass.

Some shrouded Ultor clips have been available with only very short lengths of lead attached.

WHERE TO JOIN

Do not attempt to join an EHT lead in the centre, because a discharge can occur through any insulation with which you are likely to bind the joint. Make a continuous lead as just described and join it to the Ultor clip just outside the shroud—a point which is normally remote from other metalwork.

With the leads duly attached, the EHT rectifier and line output transformer can be turned right way up and mounted permanently on the baseplate, taking care not to fracture the joints just made, nor to strain the loop and relevant insulation.

A scrap of tinned copper passed round the grommet mentioned earlier and held under one of the rectifier socket screws will support the EHT lead on its way up through the top of the cage cover.

With the transformer and rectifier socket in position, the rest of the wiring can be proceeded with, including the third tagstrip, which, as explained, attaches to the line transformer panel.

Once again, it may be necessary to use resistors in parallel to achieve the necessary 2 watt ratings, while we had to approximate the 22pF. capacitor with two 12pF. units in parallel.

COMPONENT POSITION

All components bridge directly between lugs except for a 1,000pF., which runs direct to terminal 3 on the line output transformer, and a .0022 which runs down to the end lug of the strip carrying the B-plus boost components.

The Linearity and Width coils can also be pushed into position and wired up. The Linearity coil, with only two active connections, can presumably be wired either way into circuit, although manufacturers' data implies that the start of the winding goes to B-plus and the finish to the damper diode, through the 1.5uH choke.

This last item, by the way, can conveniently be mounted between the appropriate active lug and a third spare lug on the former.

Polarity of the width coil is very important and connections should be checked against the main circuit and the subsidiary diagram.

You will find that wiring the cage is quite a tricky business and each lead

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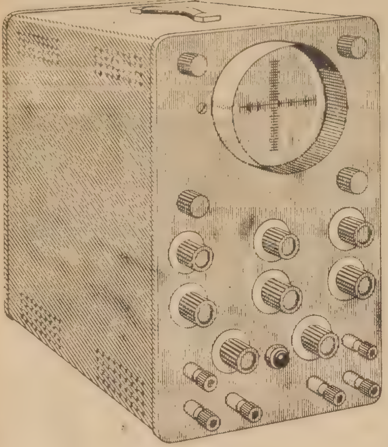

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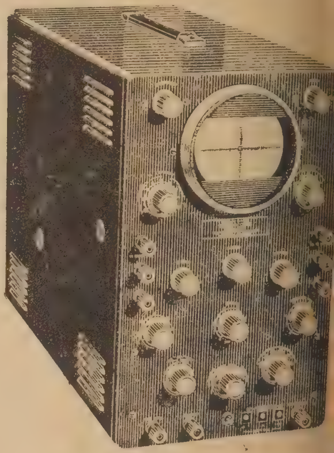

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ach component will need to be and triple checked to make sure does really go where the circtates.

the wiring completed, the cage bolted into position and the few tions made beneath the main . The receiver could now cony be tested with the picture tube d up on the bench alongside, but a rather dangerous practice. The nstructor will proceed immediatemount the tube in position.

exact height of the tube, and e-and-aft position on the chassis pend, to a large extent, on your of mask and cabinet styling. You ke your pick whether to mount e initially and modify its position or do some advanced planning.

accompanying diagram shows mounting arrangements for a 21be, which could be scaled down enough for the 17-inch variety.

CLAMP

rding to manufacturers' instruche clamp around the face of the hould not be wider than threes of an inch and a visit to a re store brought to light a stanluminium beading of this width e section indicated on the accomg diagram.

end was bent over as indicated, clearance to receive a 3-16th Vhitworth nut. Then, with another hands (and arms) cradling the he beading was bent carefully the face. This involved all but inches of the 6ft length, by the little slack was allowed for the rubber and the end bent over a socket for the clamping bolt.

earance hole in one socket will he bolt to pass through and also cess for a screwdriver to engage t in the screw head.

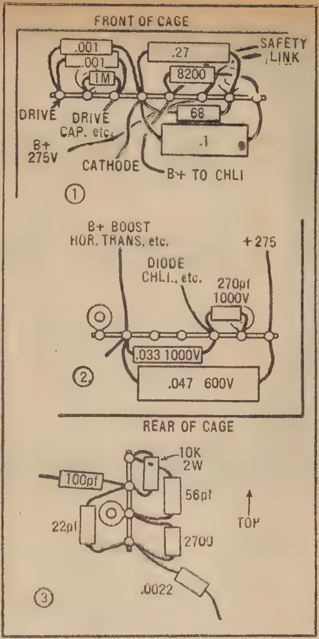
ng formed the clamp, lock it on tube face with the rubber in , check it for accurate shape and ow much of the clamping bolt sed through the nut. The rubber, way, is 1 x 1-8th inch sponge

his stage the clamp can be refrom the tube, the tube put away clamp screw tightened again to ne setting as with the tube in . If handled carefully, the clamp retain quite accurately the shape tube face.

ORT BRACKET

make up a U bracket from steel gauge aluminium, to the dimendicated ,and attach to the chassis. not be exactly central, having to he cutout mentioned last month commercial tuner. The distance he front of the chassis is typical y need to be modified according r ideas on cabinet design, mask and so on.

ng positioned the U bracket, the tube clamp beading to it, the beading over the chassis. untersunk screws and packing where necessary, to adapt the re of the clamp in the U bracket. clamp is locked to the chassis e aid of another length of alubeading, preferably a rather and stronger type. The section beading used in the original is ed, being about 1 1-8th inch wide. Its position relative to the chassis is obvious from the drawing.



These small diagrams show the suggested wiring to the three tagstrips in the EHT cage. (1) is near the front of the cage, (2) between the feet of the transformer and (3) on the panel of the transformer.

The finished bracket work is very strong and the chassis can readily be rolled on to its side with the tube in position.

The tube is supported purely by the face clamp and, in fact, the manufacturers specify that the base socket be not supported other than by the tube.

To earth the outer conductive coating, we drilled a couple of holes in the sloping support brackets and angled so that a wire stretched between them would pass across the coating clear of the Ultor connection. The "wire" is a length of copper braiding held taut at one end by a light spring.

When the tube is ultimately put into operation a substantial charge is built up on and between the inner and outer coatings. This cannot be dispelled by merely flicking a wire between the Ultor terminal and "earth." Because of the nature of the coating, the charge builds up again after discharge, or even after several discharges.

One can, therefore, easily get a shock when handling the tube. In itself, it is not dangerous, but reaction to it may cause one to mishandle the tube, with dire consequences.

With the tube in position, the yoke and centring magnet assembly can be passed over the neck, with the input leads coming in at the bottom.

In the original deflection kit, the yoke and centring magnets were separate and the yoke had to be held against the flare by a disc of wood or bakelite, slipped over the neck and held forward by a couple of springs attaching to the support brackets.

Current practice is to attach both yoke and centring magnets to a common bakelite shell, which is locked to the neck of the tube by a clamp, so that additional locking is unnecessary.

ION TRAP MAGNET

If the picture tube is of the bent-gun type, it will also require an ion trap magnet just near the base to re-direct the electron beam. The ion trap magnet must be fitted in the correct approximate position for the particular type of tube, for any raster whatever to appear on the screen. Immediately after switching on the ion trap has to be adjusted for maximum picture brightness, but more of this anon.

The ion trap is normally supplied with the picture tube but, if not, care should be taken to see that it is a suitable type. Ion traps vary in strength and are not necessarily interchangeable from tube type to tube type.

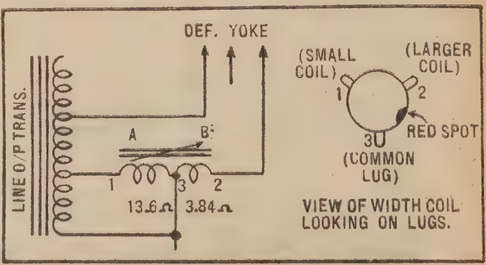
For the 17AVP4-A and the 21ALP4-A, the ion trap should be positioned initially so that the magnet block is about in line with pin 12 on the base and with the red spot downwards and adjacent to pins 9 and 10. It should be about ¼ to 3/8th inch from the bakelite base.

In the case of the AW53-80 and the AW43-80, the standard magnet supplied should be slipped on to the neck of the tube with the arrow facing away from the screen. It should be on the side diametrically opposite the line marked on the tube neck, which line is normally adjacent to the pin 3 position.

☆

Here are the essential data for connecting the width coil. Reversing the connections would probably make it impossible to obtain full horizontal scan.

☆



Two other types of picture tube, mentioned at the start of this article, do not require ion trap magnets.

With the tube, yoke and ion trap in position, the receiver should be ready for an initial test of the picture circuits.

Quite a few checks and adjustments may need to be made before best results are obtained and, all being well, these will be the subject of separate discussion in our next issue. However, for those who may want to get the receiver into operation before the issue appears

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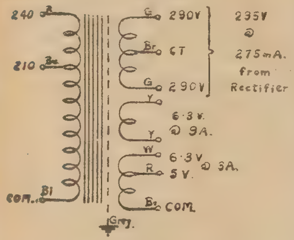
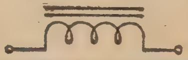


CHOKE RHE-1/275
Dimensions
Height 1⅞"
Coil Width 1⅝"
MTG. CTRS. 2¾"



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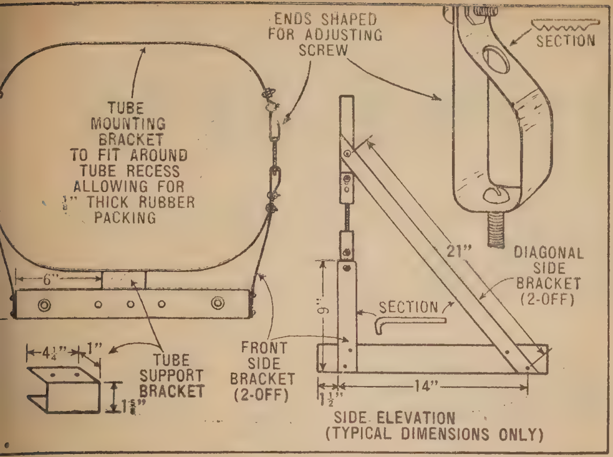
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14"
SIDE ELEVATION (TYPICAL DIMENSIONS ONLY)

diagram illustrates a simple method of supporting the picture tube, using rials available to the home constructor. The same method is applicable to 17-inch tubes.

ple of points warrant preliminary n.

n first switching on, no raster may on the screen of a bent gun tube he iron trap magnet is in its ap- ate correct position. Switch the with the Brightness control in its um brightness position (cathode to end) wait for a few moments after und is heard, then advance the ness control by about one third travel.

o pattern appears on the screen, oving the ion trap slightly about gested position, backward and for- and around the neck of the tube. e is still no pattern, advance the ness control a little further and ain.

en a pattern appears, set the ion entatively for the brightest trace. illumination is evident with the ness control well advanced, the es are that there is a fault in the circuit.

s can be verified by switching off, ing the EHT lead from the Ultor , and switching on again with the lead supported in the fingers well of any joint in the insulation. By ng the connector near the metal- of the chassis, a discharge should over a distance of about 3/8 inch, like an auto ignition spark, only uous.

ME, LINE HOLD

ustments may be necessary both frame and line hold circuits to the picture stand still, not forget- hat the Fine Tune control may have to be manipulated to get a picture. Almost any setting will sound to get through but tuning cture information is more critical.

the picture is holding in neither on, patterns on the screen are etely erratic but rotation of the Hold potentiometer should be ent to halt most of the vertical ment, indicating that frame lock has achieved.

usting the line hold circuits is a deal more complicated because an automatic frequency control system is involved.

Lacking a CRO, an initial setting up procedure is as follows:

Set the Line Hold potentiometer at half resistance, preferably with the aid of a multimeter, and short out the Sine Wave coil.

Adjust the core of the Horizontal Oscillator coil till the picture locks, then observe the total number of turns through which the core can be rotated, while still keeping the picture intact. Set the core in the middle of its locking range.

Now remove the short from the sine wave coil, leaving the potentiometer and oscillator coil strictly alone. If the picture has now torn, adjust the core in the Sine Wave coil till it locks once again.

SINE WAVE COIL

Having regained the picture, you will probably find that the picture will tear away at the top if the core is screwed too far out of the winding, and disintegrate completely if screwed too far in.

Best waveform appears to be present with the core screwed toward the latter extreme, rather than the former, though it should not be taken so close that locking is erratic when switched from channel to channel.

Having thus selected a position for the core in the Sine Wave coil, turn attention again to the Line Hold potentiometer. Swing it through its full travel and note whether the picture breaks only on one extreme. If so, make a slight adjustment to the Horizontal oscillator core so that the behaviour of the potentiometer control is more nearly balanced, holding in the centre of its adjustment and causing picture breakup at either extreme.

To be Continued.

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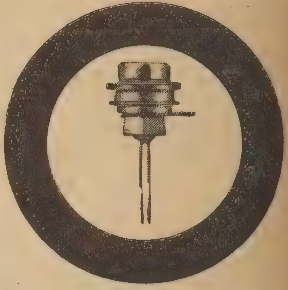

Half actual size

DATA

Characteristics (measured at 25°C ambient)

Collector reverse leakage current, grounded base	<100μA
Current amplification	
at Ic = 30mA	40
at Ic = 300mA	35
at Ic = 2A	22
at Ic = 3A	16

*** POWER DISSIPATION**

14 watts dissipation at an ambient temperature of 45°C can be allowed when the OC16 is bolted to a large but practical heat sink. The accompanying table shows allowable dissipations with difference heat sinks. In all cases the transistor is mounted directly on to a plate with a thin tin-plated lead washer.

When electrical insulating mica washers are used, the dissipation is somewhat reduced. Full data is available.

AMBIENT TEMP. (TO GIVE 75°C JUNCTION TEMP.)	DISSIPATION WITH INFINITE HEAT SINK. e.g. —WATER COOLED	DISSIPATION WITH LARGE METAL PLATE 1°C PER W THERMAL RESISTANCE	DISSIPATION WITH 1 sq. ft. METAL PLATE 2°C PER W THERMAL RESISTANCE	DISSIPATION WITH SMALL METAL PLATE (4 in. x 7 in.) 5.5° C PER W THERMAL RESISTANCE
25°C	45W†	24W	16W	7.6W
35°C	36W†	19W	13W	6.1W
45°C	27W†	14W	9.7W	4.6W
55°C	18W	9.5W	6.5W	3.0W

† *Continuous dissipation values in excess of 24W are at present prohibited by the voltage and current ratings given in the full data.*

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COMMUNICATIONS AND INDUSTRIAL VALVE DEPARTMENT

M61

SMALL HIGH-VOLTAGE SUPPLIES

h-voltage, low-current power supplies are frequently required in radiation detectors and
nters, photoflash units, insulation testers, photomultiplier circuitry, cathode ray equip-
t, photoluminescent sources, and X-ray devices. This article, reproduced by courtesy of
Aerovox Corporation, summarises current trends in design, and although some components
are not available in this country, they are mentioned for their reference value.

most power supplies in the low-
ent category are small in size
t in weight, they are well suited
n portable equipment, especially
ry-operated equipment. In recent
here has been an increasing de-
or small-sized high-voltage, bat-
rated supplies.

urpose of this article is to de-
ne types of circuits which are
mployed, giving practical ex-
and comparing their characteris-
s expected that this survey will
de in the selection of the proper
nit for a given application.

arrangements are not included
esume, since they are highly ex-
al in nature or are of a make-
aracter. Practical units which
ven themselves in the field gen-
ll under the headings: (a) bat-
b) charged-capacitor type, (c)
transformer type, (d) vacuum-
ack type, and (e) transistor os-
ype.

RIES ARE SIMPLEST

implest DC voltage supply is a
Miniature dry batteries are avail-
90- and 300-volt sizes. These
may be series-connected for
oltages than their rated values
sometimes used to build up a
ential supply.

ne applications, especially those
circuitry must be kept simple
minimum, only batteries can be
e complication and added space
nents attendant to the use of
transformers, filter chokes and
rs, and voltage regulators thus
ded.

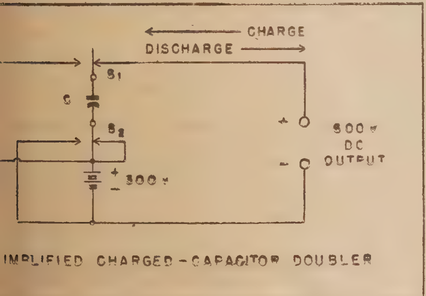

FIGURE 2

te its simplicity, high-voltage
operation is the most expensive
obtain kilovolt potentials. A high-
supply using batteries only has
est initial and replacement costs.

The milliampere-hours per unit cost rating likewise is poorer than that of other types of high-voltage supplies.

Several types of such batteries are available overseas, but it is safe to say that they are definitely low-current units, the useful lifetime of which is abbreviated sharply by all operation at high levels, as well as by long, continuous operation at low current drain.

Because of the expense of miniature high-voltage batteries, a current-limiting resistor should be connected in series with them, whenever circuit peculiarities permit, to prevent their rapid destruction in case of a short circuit.

The operator should take care to switch the batteries off at all times when they are not actually in use. A cool, dry environment is the most satisfactory condition under which such batteries should be operated. When not in use for long periods of time batteries should be stored at temperatures between 40-60 deg. centigrade.

In circuits in which current drain is quite low (i.e., under 1 milliampere), and operating time can be reduced to a series of short intervals, charged capacitors may be operated in series to supply high DC voltages. This permits a reduction of battery expense, since only one battery is needed to charge a number of capacitors in parallel, which then may be switched in series to deliver as many times the battery voltage.

The time interval during which the voltage obtained in this way may be held to a useful level depends upon the total capacitance of the series capacitor combination and upon the output current drain. At any current level, the higher the capacitance the longer the interval.

In practical circuits in which this type of supply is used, a switch (usually a pushbutton) is provided for momentarily re-connecting the capacitors in parallel for charging.

Figure 1 shows a charged-capacitor type of supply operated from a miniature 300-volt battery and delivering 900 volts DC.

When the 6-pole, 2-position switch is temporarily at its left-hand CHARGE position, capacitors C1, C2, and C3 are connected in parallel with the battery and become charged. When the switch then is thrown to its right-hand DISCHARGE position, the capacitors are connected in series, and 900 volts are available at the output terminals of the circuit. The total capacitance in the discharge condition is 0.333 mfd.

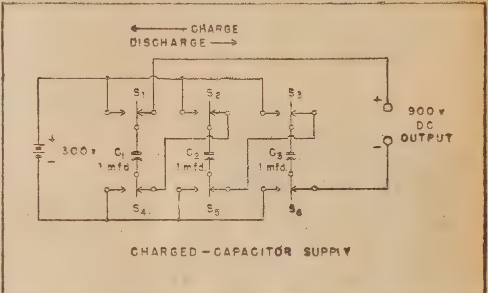

FIGURE 1

It is convenient to have the switch rest normally in the DISCHARGE position to provide a normal connection of the series combination to the output terminals. If the switch has a spring return, the capacitors are charged each time the switch is depressed or thrown, after which the switch returns automatically to the DISCHARGE position to deliver high-voltage output.

METHOD LIMITS

It might be expected that this scheme could be extended indefinitely, the voltage multiplication being proportional to the number of capacitors. It is limited, however, by the number of poles and contacts which may be included in a practical switch without the latter reaching ungainly size.

Also, in order to obtain a sufficiently high total capacitance with a large number of capacitors in series, the required individual capacitance values would become so large as to raise both the size and cost of the supply out of reasonable bounds.

Figure 2 shows a simplified charged-capacitor circuit which delivers twice the battery voltage. In this arrangement;

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ne dpdt switch temporarily is at hand CHARGE position, capaci- s charged from the 300-volt bat- Vhen the switch is reduced to its right-hand DISCHARGE posi e charged capacitor is connected s with the battery.

voltage at the output terminals the sum of the battery and capa ltages, or 600 volts.

ged-capacitor supplies basically -current, short-interval units. At ly low current drains, however, e interval during which the volt- naintained near its required level extended to a reasonable length loying high capacitances.

example: Consider 1,000 volts by a total capacitance of 100 rads. At a current drain of 100 nperes (load resistance of 10 ns), the capacitor still will have cent of its charge (output voltage ve fallen 10 per cent from its value) in 1½ minutes of opera- he circuit then may be pulsed other charge to bring the voltage to the original level.

16 minutes of operation, because exponential decay of the charge, put voltage of this capacitor will oximately 370 volts.

TOR CIRCUIT

niature vibrator-transformer and combination, similar in prin- the conventional automobile ower supply, provides the basis igh-voltage d-c operated from a nexpensive battery—often a single flash-light cell.

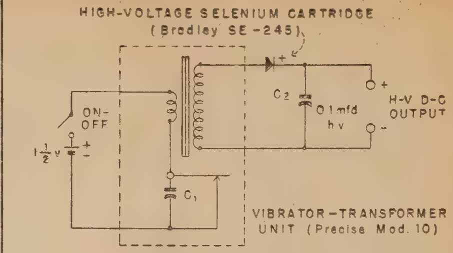
e 3(A) shows the circuit of a (buzzer) type high-voltage supply kind. This is a small unit such as Model 10 (having about the same ons as a 6L6 metal tube) which to an octal socket. The step-up mer, vibrator, and spark suppres- pacitor (C1) are self-contained. e 1½-volt, Size-D flash-light cell the DC driving voltage. Current approximately 35 milliamperes.

igh-voltage AC, generated by the -transformer, is rectified by a high-voltage selenium cartridge- tifier and is filtered by the 0.1- acitor, C2.

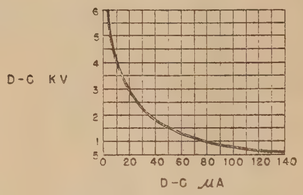
open-circuit output potential is olts DC. Figure 3(B) shows the regulation of the circuit. From t, it may be seen that the out- age falls to approximately 500v rent drain of 140 microamperes esistance of 3½ megohms). A l of 1 kv is obtained at 70 μa The output voltage may be re- through the use of a filamentless miniature regulator tube such as Type CK5517 for 2.3 kilovolts, 5841 for 900v, or CK1036 for 700 volts.

At light current drains (under 150 ua), adequate filtering action will be provided by capacitor C2. In applications requiring increased smoothing of the output, a 100,000-ohm filter resistor and additional 0.01-ufd capacitor may be employed.

The vibrator-type D.C. supply is compact and tubeless and is light in weight. The size D flashlight cell, which drives it, is small and inexpensive and will give 150 hours service when used continuously two hours per day, and 60 hours on a 24 hours - per - day basis.


HIGH-VOLTAGE SELENIUM CARTRIDGE
(Bradley SE-245)
ON-
OFF
1½ v
+
C₂
0.1 mfd
h v
+
H-V D-C
OUTPUT
-
C₁
VIBRATOR-TRANSFORMER
UNIT (Precise Mod. 10)

(A) CIRCUIT



(B) VOLTAGE REGULATION

BUZZER TRANSFORMER-TYPE SUPPLY

FIGURE 3

Figure 4 shows the circuit of a high-voltage supply which utilises the rapid decay of plate current (flyback) through a high inductance to generate high-voltage pulses. The resulting pulse train is rectified and filtered for D.C. output.

In this circuit, a relaxation oscillator (comprised by the NE-2 neon bulb, capacitor C1 and resistor R1) is operated from the 135-volt battery, B2. The output of this oscillator is coupled, through capacitor C2, to the IT5 tube. (A miniature type 3S4 tube also may be used.)

Inductor L in the plate circuit of this tube is a miniature interstage transformer with its primary and secondary windings connected in series-aiding. Plate and screen potentials for the tube also are supplied by battery B2. Filament current is supplied by B1. The quiescent plate current is quite small. However, the rising positive-going portion of the saw-tooth pulses from the relaxation oscillator increases this current to a maximum. With the rapid fall or flyback of the saw-tooth the plate current collapses and a high voltage pulse (e) is generated across inductor L:c—L (di/dt).

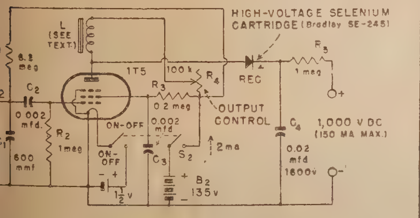
The high voltage selenium cartridge rectifier (R—EC) serves to pass the positive swing of the voltage pulses and to block the negative swing. The connections of this rectifier may be reversed for negative D.C. output if desired. Rheostat R4 serves as an output voltage control by permitting adjustment of the plate current. Screen current is limited by the 200,000 ohm resistor R3.

BATTERY OPERATED

The circuit may be operated from a 1½-volt, size D flashlight cell at B1 and two midget 67½-volt batteries in series for 135 volts at B2. Resistor R5 is included for output current limiting to protect the rectifier in the event of an external short circuit and to safeguard the operator in case of contact. This resistor may be omitted if it causes too large a voltage application.

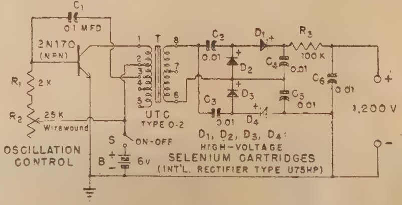
In the compact power supply shown in Figure 5, the signal-output voltage of a transistorised oscillator operated from a small 6-volt battery is stepped up by transformer T.

The secondary voltage of the transformer then is applied to a voltage quadrupler circuit (consisting of selenium cartridges rectifiers D1, D2, D3, D4, and capacitors C2, C3, C4 and C5,


L
(SEE
TEXT)
6.2
meg
C₂
0.002
mfd.
600
mmf
R₂
1meg
1T5
100 k
R₃
0.2 meg
R₄
ON-OFF
0.002
mfd
ON-
OFF
1½ v
C₃
S₂
B₂
135 v
2ma
OUTPUT
CONTROL
HIGH-VOLTAGE SELENIUM
CARTRIDGE (Bradley SE-245)
REC
R₅
1 meg
+
C₄
0.02
mfd
1600v
-
1,000 V DC
(150 MA MAX.)

SIMPLE FLYBACK-TYPE SUPPLY

FIGURE 4


C₁
0.1 MFD
2N170
(NPN)
R₁
2 K
R₂
25 K
Wirewound
OSCILLATION
CONTROL
T
1
2
3
4
5
8
7
6
UTC
TYPE O-2
S
ON-OFF
B
6v
C₂
0.01
D₁
D₂
D₃
D₄
C₃
0.01
C₄
0.01
C₅
0.01
R₃
100 K
C₆
0.01
+
-
1,200 V DC
D₁, D₂, D₃, D₄:
HIGH-VOLTAGE
SELENIUM CARTRIDGES
(INT'L. RECTIFIER TYPE U75HP)

TRANSISTORIZED H-V SUPPLY

FIGURE 5

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livers a D.C. output equal to the applied A.C. voltage. The oscillator is a Hartley-type The required tapped coil is ob- connecting to primary ter- 2 and 3 of the miniature line- ansformer (U.T.C. type 0-2). secondary winding (taps 6 and

ly, experimenters have been ful in boosting the voltage out- low-voltage transistor oscillator small transformers with suffi- gh turns ratios and primary in- have not been commercially The type used here is known "Ouncer."

,000-ohm rheostat, R2 allows bias current to be set for easy f the oscillator and for full ts D.C. output. This control set so that the oscillator starts when the ON-OFF switch, S A D.C. vacuum-tube volt- to its 0-1,500-volt range and to the 1,200-volt output ter- hould be used as an indicator s adjustment.

TY IMPORTANT

ilder must be careful to fol- xact polarities indicated in Fig- the transistor, battery B and ers.

ors C2, C3, C4 and C5 lard 500-volt mica compon- utput capacitor C6, however, rated at 1,600 volts D.C. or

drain from the 6-volt battery mately 2½ milliamperes. This rement may be met even with es-connected 1½-volt penlight

model, transistorised high-volt- r supplies presently are avail- mercially in America in ratings 00 volts D.C. output. Custom be obtained up to 100,000 . All of these units operate or two 1½-volt flashlight cells or from mercury cells. One such unit together with its cell is no larger than the Geiger tube it is designed to power.

One company has developed a miniature version of the Wimshurst static machine, familiar to all science students. This reduced-scale model is spun by means of gearing operated by means of a pushbutton, and delivers several kilovolts from a charged capacitor.

Attention again has turned to the electret as a repository of high-potential charges. Electrostatically, this device is somewhat analogous and dual to the permanent magnet. It has been known for several decades but has found no noteworthy practical application up to this time. Essentially, it is a cake of carnauba wax that has been cooled down from the molten state while in a high-voltage electrostatic field. Research and development work presently is being pursued to determine the potentialities of the electret as a high-voltage D.C. supply.

HANDLE WITH CAUTION

Every high-voltage supply should be handled with caution. Miniature units are no exception. Although, in most instances, miniature supplies are incapable of delivering damaging currents, the voltages that they do put out can cause dangerous reflex actions which have been known to cripple the heart and cause death. High-voltage batteries are especially nasty.

Small, high-voltage supplies often are more deadly than full size units, simply because of their deceptive size. Being small and quiet, they just do not look dangerous. However, the false sense of trust they inspire encourages only a stupid technician to grow careless with them.

Regard all high-voltage supplies as threats to personal safety and well-being. Know your circuit well and avoid all bodily contact with its high-voltage points.

TV tape recording machine for B.B.C.

(Continued from Page 15)

a requirement will arise in the gnetic vision recorders for the programme previously record- e editing, in the form of re- xtracts from a previously re- ogramme, may be achieved by he machine at any predeter- nt in the recording. This facil- ilable because the machine is with the usual facilities for the tape backwards and for- find a desired point in the re-

thod may be extended, as in sound-recording practice, by d joining extracts from various or different parts of the same Individual frames cannot, be examined in a "gate", as film editing, for the tape must uced at the correct speed before can be reproduced on a moni-

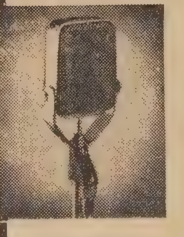
g arrangement for the "mark- editing points has, therefore, ided. The method adopted is an extra cueing head, lying e isolated tape loop, which is gh a separate recording amplifier from a 30 kc/s oscillator. When the tape is being normally reproduced and the observer wishes to mark some particular point for subsequent cutting or starting he presses a "Cue" key on the control panel of the machine which causes a 30 kc/s burst of signal to be recorded on the sound track of the tape.

At this frequency it will not appear in subsequent normal reproduction since it lies well below the frequency-modulated carrier signals which carry the sound programme and any interference effects it might otherwise have will be removed by the limiting process which precedes detection of the television sound signal.

However, when the tape is being slowly transported past the reproducing head, using the spooling speed control, at a fraction of the normal speed, the cue signal will produce an audible note in the loudspeaker or head-phone system so that the point previously marked is found. The cutting and joining of tapes is accurately and quickly carried out by the use of a splicing device provided and the resultant join provides no visible disturbance in the picture.

AWA RONETTE

MICROPHONES & ACCESSORIES



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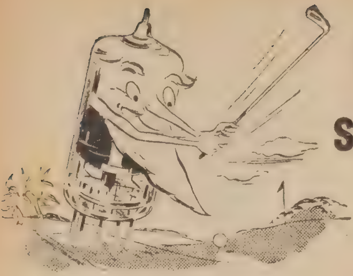

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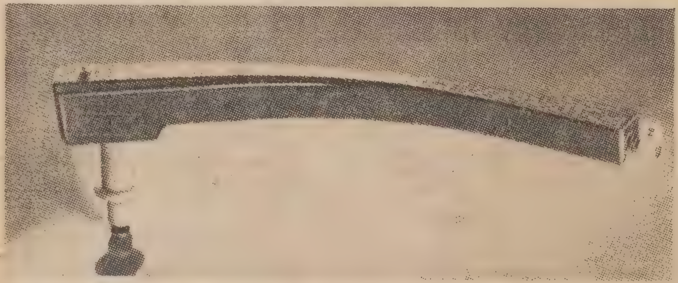

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NDAMENTAL TRANSISTOR THEORY

second part of this article continues a discussion of how transistors work, and carries
to the field of standard circuit connection. On pages 4-7 of this issue you will find a
picture story which tells how transistors are manufactured.

e now discussed two distinct
ermanium crystal, the N-type
material and the P-type or ac-
terial. Figure 14 shows a piece
material joined with a piece
material. Since the N-type

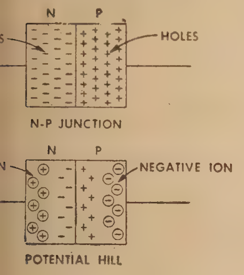
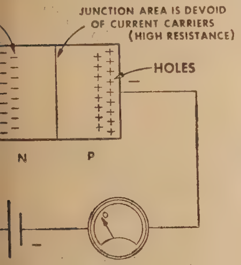


Figure 14

as an excess of electrons and
has an excess of holes, posi-
t carriers, it may seem logical
these two materials are joined
e excess electrons would flow
e junction and neutralise the
holes.
ill indeed be a tendency for
ns to congregate at the junc-
e N-type material and like-
traction for the holes to con-
the junction in the P-type
hese current carriers will not
neutralise themselves; how-



—NP Junction with "reverse" bias.

movement of electrons and
e negative and positive ions
duced.
ans an electric field is set up
pe material that will tend to
e movement of current car-
gh the junction.
ative ions in the P-type mate-
epel the negative electrons in
material and the positive ions
type material will repel the
oles in the P-type material.
s up what is called a potential
although very slight recom-
the junction does take place,
ial hill is soon built up to a
no further recombination will
without the application of an

PART 2

external difference of potential. Now let's consider an N-P junction to which we do apply an external voltage.

In Figure 15, we see that a small battery has been connected in series with an ammeter so as to apply a voltage to the two germanium crystals. You will notice that the positive electrode of the battery is connected to the N-type material and the negative electrode of the battery has been connected to the P-type material. Since the N-type material has an excess of electrons, the positive voltage being applied to this material

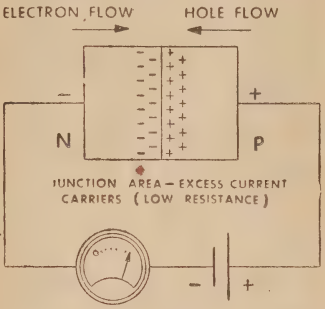


Figure 16—NP Junction with forward bias.

will attract these electrons toward the left end of the germanium crystal pellet. The negative voltage being applied to the P-type material, which has an excess of positive current carrying holes, will attract these holes toward the right end of that pellet and away from the junction.

The ammeter indicates no current flow, since there is no possibility of recombination at the junction because the potential hill has been built up to a higher value by the application of an external voltage. We call this the reversed biased condition or high resistance circuit. You will notice that with this type of connection, the area around the junction is now a good insulator since few current carriers can be present. We can connect the battery in the opposite polarity and cause a different condition.

In Figure 16, we have reversed the battery polarity and now the negative electrode of the battery is connected to the N-type material. This negative voltage will repel the electrons in the N-type material toward the junction. The positive electrode of the battery is connected to the P-type material which will repel the positive holes toward the junction.

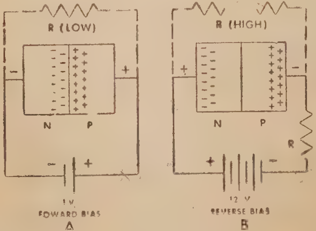
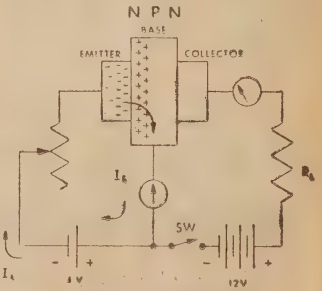


Figure 17

With this type of connection, recombination takes place at the junction resulting in current flow through the N-P junction as indicated by the reading of the ammeter. Since current carriers are plentiful in junction area of the two materials, it now offers a low resistance to the flow of electric current.

This method of attaching the battery is known as forward bias since it encourages current flow. It is important to remember that in this circuit, the electrons are flowing from left to right and the holes are effectively flowing from right to left.

Shown in Figure 17 are two germanium diode circuits. The one at Figure 17A has a low internal resistance because it contains a battery which is connected in the forward bias direction placing current carriers on each side of



COMMON BASE CIRCUIT
Figure 18

the junction so that electric current can easily travel through the junction. The low resistance of this circuit is represented as an equivalent resistor R shown in dashed lines.

Notice that in Figure 17B the battery is connected so that the holes in the P-type material and the electrons in the N-type material are attracted away from the junction, leaving an insulating area on each side of the junction. This is the reverse bias connection and results in an extremely high resistance as explained above.

The resistance to the flow of battery current is now so great that it may be illustrated as an open resistor in comparison to the circuit in Figure 17A. No appreciable current would now be able to flow through the load Resistor R even with the increased battery voltage, and there would, therefore, be no voltage drop produced across it.

From Figure 21, we see that we have connected two pellets of N-type germanium and one pellet of P-type germanium in the form of a sandwich.

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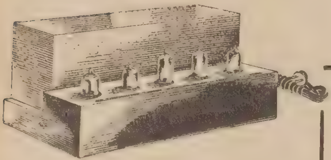

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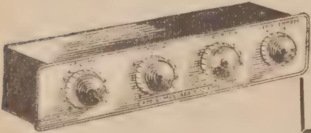

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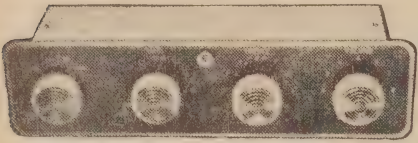

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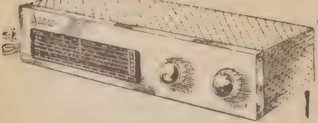

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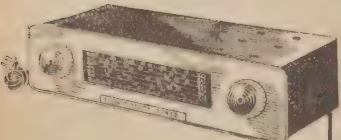

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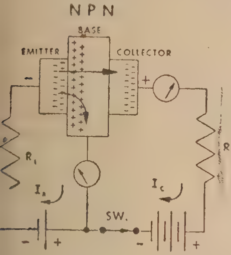
-type material is the bread or the sandwich and the P-type is the meat. The names emitter, collector have been given to elements of the sandwich. We hat the collector circuit is open. tter is returned to the base a small battery and you will at this battery is connected so the base-emitter circuit in for- s. The negative voltage at the



e 19—Common base circuit.

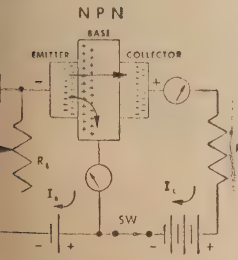
vill repel the electrons in that toward the junction and the voltage at the P-type material in turn repel the holes toward junction.

bination then takes place result- e current flow, labelled Ib. We e the forward bias condition or tance circuit in the emitter-base Looking at the collector circuit, hat we have the positive elect- the battery connected to the naterial collector.

egative electrode of the battery cted to the P-type base when ch is closed. You will notice biases the collector base cir- he reverse bias condition, which scussed before, would not allow ent flow through the collector uit. Now, let's close the switch collector circuit and see what ce.

he switch closed in the collector Fig. 19) we notice that we now ne current flow in the collector This is true even though we collector base circuit biased in se or high resistance direction. e how we obtain this current

egative voltage being applied to ter will set its electrons into They will move toward the junc- break through. Base material ely thin at that point and ap- ely 95 per cent of the current will pass right on through and e collector circuit. With the biased reverse, all of the elect- attracted toward the positive the battery.



e 20—Common base circuit.

As electrons leave the emitter and pass into the base material, they come under the influence of this strong positive field and are accelerated into the collector. As one electron enters the collector, it will force another out of the collector through the load resistor and to the battery, resulting in current flow.

As mentioned above, approximately 95 per cent or more of the electrons passing through the emitter base junction will enter the collector circuit. That leaves only five per cent or less of the electrons to recombine with positive holes in the base material which will constitute our base current. You might say at this point that all we have really accomplished is to create a device that will result in current loss. This is true since the emitter current will always be greater than the collector current in this instance. However, let's look at it in another way.

The emitter-base circuit, which would be the input circuit in this case, is biased in the forward direction resulting in a low resistance circuit. The collector is biased in a reverse direction which results in a high resistance circuit. You will notice that the collector current will be only slightly smaller than the emitter current but with the difference that the collector current is flowing through a much higher resistance circuit than in the emitter. This will result in voltage gains developed across the load resistor Rl, or amplification.

We now have a complete transistor and we can see where the device gets its name. The input circuit is a low resistance circuit; therefore, we have to transfer from low to high resistance or a transistor. We call this type of circuit a common base circuit since the base is common to both the input and the output. Let's put a signal voltage into this circuit and trace the electron flow to see what takes place.

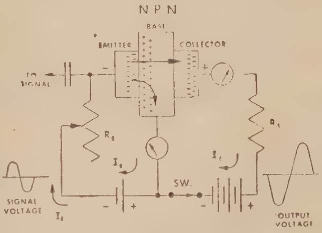


Figure 21—Common base circuit.

Looking at Figure 20, we see that a coupling capacitor has been added which is used to couple the signal into the emitter base circuit. A potentiometer, Re, has also been added to the base emitter circuit.

This potentiometer can be adjusted for the right amount of forward bias on the emitter base circuit. In other words, this potentiometer will be adjusted so that under static conditions, we will have a certain amount of current flow in the emitter base circuit. This will also result in some collector current. Let's trace the electrons through this circuit under static conditions.

The electrons will leave the emitter and travel through the junction into the base material, at which time, five per cent or less of these electrons will recombine with holes in the base and result in base current as indicated by Ib.

Ninety-five per cent or more of the electrons will pass on through the base material due to their high velocity and the strong positive field at the collector base junction and will enter the collector resulting in the flow of collector current as indicated by Ic. All of these currents are indicated as electron flow.

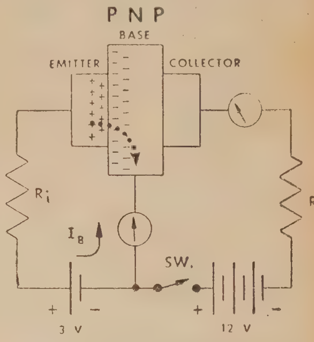


Figure 22—Common base circuit.

In Figure 21, we see the same circuit as before, only now we have a signal voltage being applied. You will notice that as the signal voltage rises in a positive direction, the emitter will be made less negative with respect to the base. This will result in a reduction of the forward bias of the emitter base circuit and therefore reduction in current flow through the emitter.

Since the emitter current is reduced, the collector current will likewise be reduced at the same proportion. As the signal voltage starts increasing in a negative direction, the emitter will now become more negative with respect to the base resulting in increased forward bias in the emitter base circuit and increased current flow activity in the emitter. This will result in a corresponding increase in collector current.

We have now reproduced the signal being applied to the emitter base circuit in the collector circuit, however it has been greatly amplified due to the fact that the current flowing in the collector circuit is through a higher impedance network. This can be seen by the relative size of the signal voltage present across the load resistor Rl as compared to the size of the signal voltage curve in the input circuit.

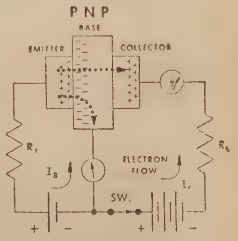


Figure 23A—Common base circuit.

We have discussed the operation of the N-P-N type transistor. It is also possible to reverse the sequence of the germanium pellets giving us a P-N-P type transistor.

In Figure 22, we can see a common base type circuit, similar to the one we just discussed in which the N-P-N tran-

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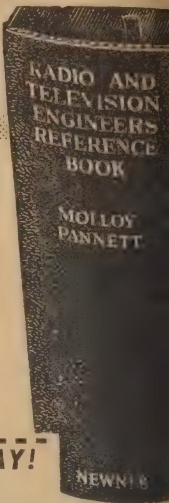

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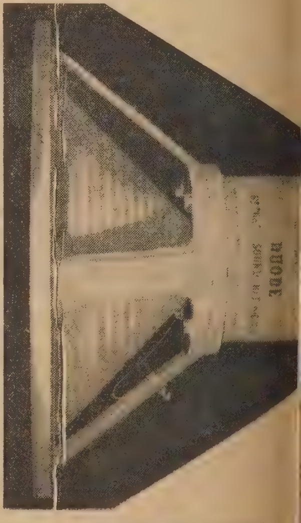

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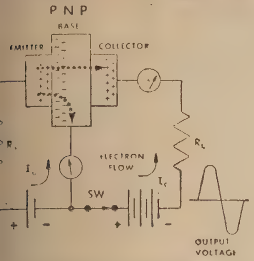
s been replaced with a P-N-P
. Notice that the switch in the
circuit is shown in the open
and the battery in the base
ircuit is connected so that the
electrode is to the emitter and
tive electrode to the base. This



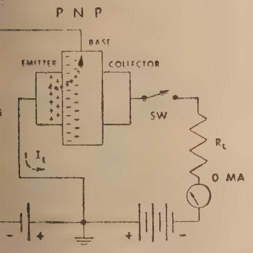
23B—Common base circuit.

he opposite of what we had
N-P-N transistor; however,
ection also will give us forward

pplication of the positive volt-
e P-type emitter will repel the
holes in that element toward
er base junction. The negative
eing applied to the N-type base
the electrons in that element
he base emitter junction. The
the emitter will move at high
nd puncture the junction, there-
ing an electron to enter the
om the base. The movement of
les through the base emitter
will constitute our base cur-
This current will occur under
ditions and will constitute our
bias current.

the collector circuit switch is
igure 23A, we again see that
current results since the holes
hrough the base emitter junc-
enter the strong negative field
y the reverse bias connection
ollector base circuit. Therefore,
nt or more of the holes leaving
er will pass right on through
region and enter the collector

a hole enters the collector cir-
electron will enter the collector
battery through Rl to neutral-



24—PNP Common base circuit.

xcess hole that now exists there.
ults in electron current flow
the external circuit. Here again
ctor current is slightly less than
ter current, but the collector
will result in voltage amplifi-
cross Rl, a much larger resis-

ure 23B, we see that we have
signal through a coupling capa-
he emitter so that the input sig-
veloped across R1. As the signal
voltage causes the emitter to be driven more positive with respect to the base, the emitter base current will naturally increase. This increased activity in the emitter will also result in an increased collector current, resulting in an amplified voltage being developed across the load resistance Rl.

As the signal voltage swings the emitter in the negative direction, the emitter forward bias is decreased resulting in less current flow through the collector circuit and giving us an exact duplicate of the input signal across the load resistor Rl, except that the voltage has been amplified.

Common Emitter

Another circuit that will be encountered quite often will be the common emitter circuit. You will notice in Figure 24 that the base is returned to the emitter and the collector is also returned to the emitter. We have the base emitter circuit biased in the forward direction by means of a small battery with the negative electrode connected to the N-type base and the positive electrode connected to the P-type emitter.

Here, as before, the positive voltage on the emitter will repel the positive holes toward the base emitter junction

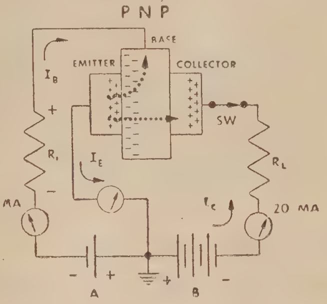


Figure 25—Common emitter circuit.

through which they will pass giving us base emitter current. With the switch in the collector circuit open, we notice that we have one milliamp of base emitter current. You can see also that the battery in the collector circuit is placed so as to inject reverse bias between the collector and emitter. When we close the switch, we will find the result to be rather startling.

You will notice that with the switch in the collector circuit closed, (Fig. 25) our base emitter current is still one milliamp and our collector current reads 20 milliamps. Since the input is across the base emitter and the output is across the collector emitter, we see that we now have a current gain of 20. Let's see how this takes place.

As we said before, the holes that leave the emitter will enter into the base region, but due to their high velocity, and due to the strong negative field put out by the collector, will pass right on through the base material and enter the collector. Only five per cent or less of those carriers leaving the emitter will enter the base and return to the emitter through that circuit.

The other 95 per cent, or more, will enter the collector and constitute collector current. Now we can see that under static conditions, we do have base emitter current and we also have collector current, even though the collector is biased in the reverse direction.

As Figure 26 shows, we have injected a signal into this common emitter circuit. You can see that the signal is injected between the base and emitter, which is a low impedance, low current circuit. The output is taken from the

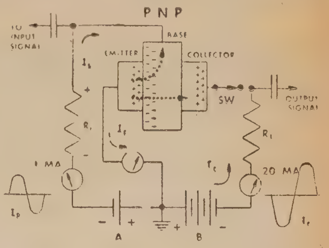


Figure 26—Common emitter circuit.

collector, which is a high impedance, high current circuit.

As the input signal causes the base to swing positive with respect to the emitter, it decreases the forward bias of the base emitter circuit, thereby causing a decrease in the collector current as is shown by the negative half cycle of the collector voltage.

During the negative half cycle of the input signal, the base is driven more negative with respect to the emitter, increasing the forward bias and allowing more current carriers to be released from the emitter which will result in an increased collector current.

This can be seen by the positive half cycle of the collector voltage. You can readily see that this type of circuit would be an excellent voltage amplifier as well as a good current and power amplifier. Current gains of values up to 99 are possible with this type of circuit.

For instance, if 96 per cent of all the current carriers leaving the emitter went on through to the collector and only four per cent combined with electrons in the base region, our current gain would be 24. If the percentage of current carriers reaching the collector was 98 per cent and only two per cent combined with electrons in the base material, our current gain would be 49. The common emitter type circuit will probably be the most frequently used type of configuration in transistor circuitry.

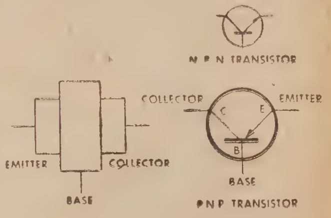


Figure 27—Schematic symbol.

Up until now, we have indicated the transistor by means of blocks for each of the three elements. The common type of symbol that you will encounter in circuit diagrams on transistorised radios is shown by means of Figure 27. The emitter element is always indicated by the line with the arrow on it. If the arrow is pointing in toward the base, this signifies a P-N-P type transistor. If the arrow points away from the base, this signifies an N-P-N transistor. The

(Continued on Page 93)

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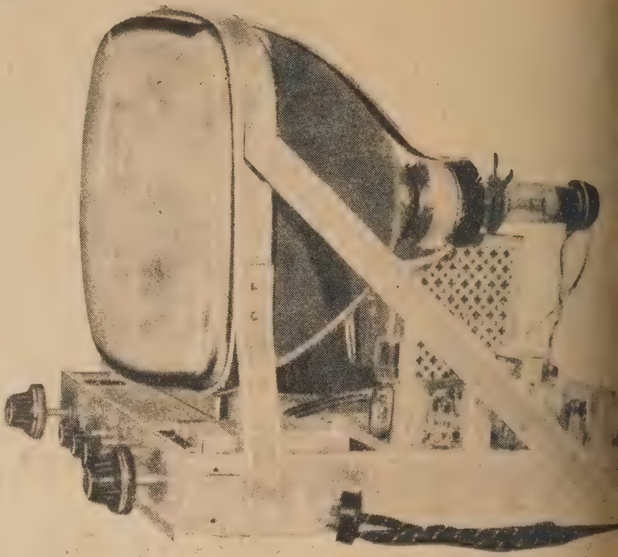

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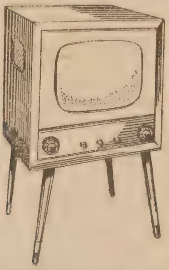

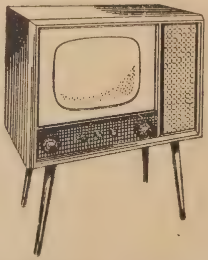

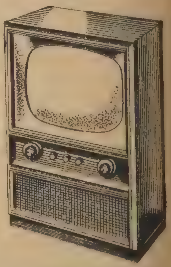

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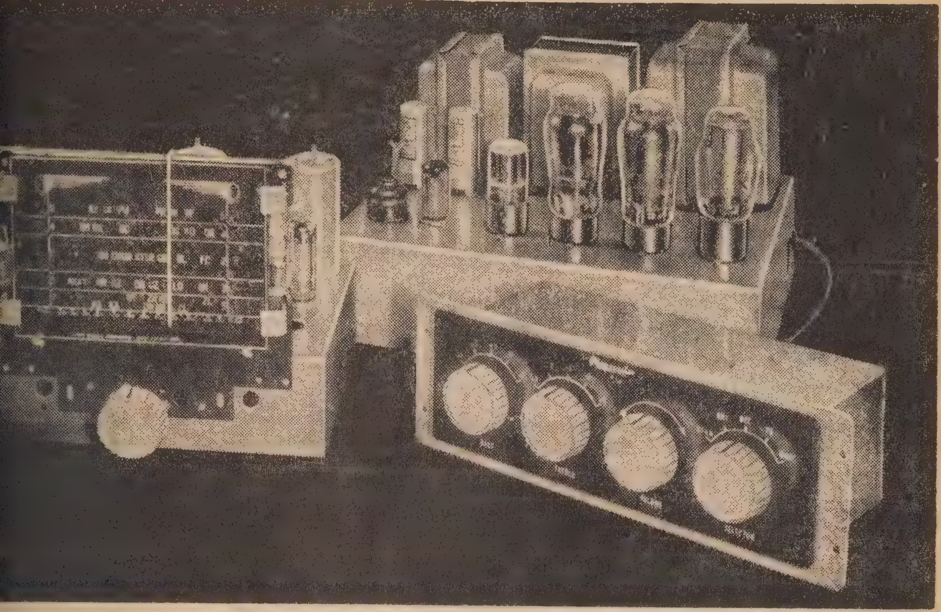

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● CF103	30	60	475	3
● CF105	15	80	325	3
● CF104	30	80	580	3
● F6-100	6	100	210	1
● F12-100	12	100	265	1
● CF106	12	100	200	3
● CF107	30	100	375	4
● CF196	20	125	255	4
● CF108	12	150	180	4
● CF109	20	150	225	4
CF396	4	200	50	3
● CF110	12	200	105	4
CF111	16	200	165	4
● CF112	10	250	80	4
CF113	5-20	250-5	80	4
● CF388	1	285	26	2
● F1-285	1	285	48	1
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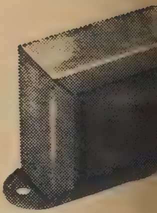
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FIRST TEST WITH THE NEW STEREO RECORDS

by John Moyle

since the stereo disc became a possibility I have been looking
rd to playing some for myself. A few days before going to press
I received both a pick-up cartridge and some records.

nort a time, and with a limited
am material, it would be prema-
be too dogmatic about my re-
But there are a number of im-
which might be of value, al-
ome of them apply to stereo as
not merely to stereo records.
ck-up I used was an Acos pre-
n sample which Amplion re-
airmail and made available to
records I imported from
where they are sold in limited
so that experimenters will
ething to use.

ck-up has twin elements driven
nmon stylus to which they are
a nylon bridge. It looks quite
d should not be unduly expen-
embering it is virtually two
one with a diamond stylus.

PROGRAM

ogram included two sides of
oises, mainly engines shunting
s and forwards, a pop singer
hestral accompaniment, and
ng bands. For the sake of my
am hoping for more variety

nplifiers were two Playmasters
vidual controls — the speakers
Wharfedales and a Rola 12UX.
enough time to adjust pick-up
c. for best results, but the head
vell enough using much lower
n recommended so that char-
approximated magnetic out-
re was no time to check
etc.

reo effect is present to a most
y degree. There isn't the
doubt about the spatial pre-
gives over a single channel on
of program. The railway record
gimmick type, for it clearly
the movement of an engine
across the room, an excellent
distance for whistles and sirens,
eneral air of movement and

me aural 3-D effect can be
the orchestra together with a
paration of sections, often re-
when the recording plays it up.

FUTURE

, the stereo disc works. There's
antalising future in it. It will
a wider and different kind of
on.

w for some brief comments on

l separation, although depen-
ely on pick-up and speaker
, is very marked. The pick-up
out 20 db, if so that's enough
separate a drum and a trumpet
ad test.

room, good separation is
with about 5ft between speak-
than this gave a hole in the
Even closer spacing — 3ft be-
tres — gave good stereo, indic-
t a wide, single cabinet can
ly be used in average rooms.

between channels must be
best effect. One record had a
Kc band for balancing, but a
est disc would be invaluable.

You can balance fairly well on surface noise, but it's very difficult on program. The speakers should have the same general character—if one leads in the middle or upper range, that prevents good balance over the full band and degrades the effect. I had difficulty here with my vastly different set-ups.

There is a noticeable separation in the bass, or at least the upper bass.

Single source speakers, or close grouping of multiples, give best stereo. More elaborate systems, while giving better sound, need larger rooms or they will be hard to control. Diffused high, a la Wharfedale, might well be out.

The room is very important. Wall reflections, etc., are significant. There's a good deal of experiment to be done, and every case is likely to be different. I have a feeling that the subtle differences will be more important than the obvious ones for serious music. It would be easy to overdo the phenomenon of sound separation.

DIRECT RADIATION

The technique of bringing the speakers close together and facing them outward mightn't be so good. The direct radiation from the speakers is the prime consideration, not reflected sound.

The speakers should be mounted at the same height and in the same plane.

The quality of the records I've heard is quite on a par with the best monaurals. Frequency range is excellent and I was not aware of any significant distortions. First impression is that the discs are first-rate, and that recording amplitude is high.

Surface noise doesn't seem to be greater than normal, but I'd like to adjust responses before saying more. If present, it will degrade the stereo effect, as does anything which is completely common to both channels. Fundamentally it doesn't seem to be a problem.

A good pick-up arm and good tracking are essential, as side pressure will degrade at least one channel. Groove tracing is a much more complicated matter. The motor I was using is good, but not faultless, and I had no rumble troubles.

High volume is not favoured, and can degrade the stereo effect if too high for the room. Splitting the power into two channels makes the whole thing sound louder. As I suspected, we are in for a drastic revaluation of the things that make a record sound good.

By the time the next issue is due, I hope to have some further comments to make, and perhaps a suggested circuit for a simple stereo amplifier. I also hope to get some more records.

If not, I'll have to learn to love those train whistles, or go balmy.

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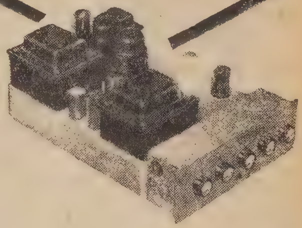

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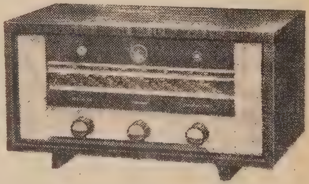

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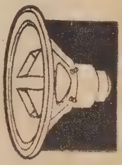

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Let's Buy An Argumen

A correspondent to the editor of "The Proceedings of the Institution of Radio Engine
(Aust.)" has raised what I think is an important matter at the right time. He draws atten
to the need for standardising values for high impedance voice coils. Read his letter oppos

by **Neville Williams**

TO some, the mere reading of the letter will be sufficient. Many others, however, will wonder what it is all about — this sudden interest in high impedance voice coils. Well, if you are so wondering, a brief review of the situation may be helpful.

Over the last thirty years, we have accepted the moving coil loudspeaker as being the standard type for receivers and amplifiers. We have understood that the coil must have as little mass as possible, consistent with mechanical strength, and be thin enough to work inside a narrow gap in the surrounding magnetic circuit.

A VAST GULF

To meet these requirements without undue difficulty, voice coils have conventionally been wound with comparatively few turns of wire and the summation of their mechanical, inductive, capacitive and resistive quantities has given nominal impedance values lying, for the most part, within the range of 1 to 15 ohms.

This "practical" range of voice coil impedance values is so far removed from the orders of plate load required by power amplifier valves, that we have accepted, almost automatically, the principle of using a coupling transformer between the valve plate circuit and the voice coil terminals.

The turns — and therefore the impedance — ratio is arranged so that the impedance of the particular voice coil is "transformed" to whatever higher value is required as a load for the output stage.

Incidental to its main job, the transformer provides a DC path for the valve plate current, adds the divergent plate current effects of push-pull stages and also isolates direct current and voltage from the voice coil circuit.

These functions are all very useful
in themselves but, in other respe
transformer can be regarded as
senger." a definite nuisance. in

In cheap receivers and ampl
occupies space somewhere, adds
overall cost, introduces a sig
quota of distortion and mana
waste anything up to a third of th
power fed into it.

In high fidelity equipment
much less distortion and absorb
less power — but only becaus
designed as a very bulky and v
pensive item of equipment. Hi
thusiasts know this only too wel

PHASE ROTATION

And, for all its bulk and c
transformer manages to in
enough phase rotation at very l
very high frequencies to complic
use of extensive negative feedb

Then why not get rid of it?

Well, "transformerless" output
have been a forlorn kind of dre
many years, but transformers ha
on and on. Right, now. howev
idea is undergoing a certain am
re-examination, stemming fron
main sources.

First and foremost, transistor
amplifiers require much lower or
output load than their valve c
parts, figures running from just
the present range of voice coil
ances to a few hundred ohms.

Since the gap between the t
of values is so much narrower,
to the obvious thought . . . w
reduce the gauge of wire and
the number of turns on the vo
to produce directly the require
of impedance? The need for
down transformer would thus di

A FURTHER STEP?

Now comes step two: If it is
practical to wind voice coil imp
as high as several hundred ohn
not go a little higher again t
them into the range where they w
the requirements of valve a
specially designed to work ir
valves) a low load impedance?

If it should be necessary to p
centre-tap for either applicatio
of it? Two connections have to
vided anyway, so why not a t
all cases the cost and bulk of a
transformer would be avoided w
wide range amplifiers, the pha
problem it presents would be
also.

Such is the train of though
superficial basis.

PREFERRED VALUE VOICE COILS

Dear Sir,

With the introduction of transistors to entertainment equipments such as portable radio receivers and record players, design engineers are seeking to eliminate the output transformer and couple the output transistors directly to a loudspeaker of suitable voice coil impedance. Such loudspeakers are commonly known as "high impedance voice coil" types and by far the most common circuit technique to permit this method of connection is for the output transistors to be arranged in asymmerical or single ended push pull.

A wide variety of load impedances appears necessary to match not only different types of output transistors but also for different operating conditions—supply voltage and the ratio of peak to quiescent collector currents — for any given pair of transistors. As a consequence, it could be that loudspeaker manufacturers will be besieged by setmakers requesting all sorts of odd values of high impedance voice coils, which is not only uneconomical to the loudspeaker manufacturer, but a factor which I feel the industry will realise in years to come is a rod for its own back

The solution would appear to be obvious, but as to date I have not seen in any of the current literature a plea for standardisation in this regard, I would suggest that loudspeaker voice coil impedances for this application be confined to E.I.A./R.E.T.M.A. values extrapolating from the already standard 15 ohm voice coil, and thus I foresee loudspeakers of 22 ohm, 33 ohm, 47 ohm and 68 ohm. These values can cope with the majority of applications, as indeed tentative measurements indicate a variation in load impedance by 20 per cent will reduce the available power output by less than 2 db.

It is not the intention of this note to suggest that a loudspeaker manufacurer would of necessity make loudspeakers with voice coil impedances of these four values, but rather where he has a demand for a loudspeaker of this type that he should standardise his voice coil impedance at the nearest E.I.A./R.E.T.M.A. value. It could well be that for some special application the intermediate 10 per cent values of 18 ohm, 27 ohm, 39 ohm and 56 ohm may be desired, but measurements to date indicate that for commercial equipments the marginal increase in performance does not warrant the addition of these further preferred values.

Yours faithfully,
MULLARD-AUSTRALIA PTY. LIMITED.
(Sgd.) J. R. Goldthorp.

se of us who are not expert in ianufacture, first reaction to the n is that it may be impractical voice coils of increasingly high e. without involving prohibit- gauges of wire. Or, if such sed, can it possibly be terminatly or not be unduly subject to or chemical decomposition?

atively, if the bulk of the coil d to increase, in order to acte a more practical wire gauge, the sensitivity and frequency of the speaker suffer, as comth lower impedance types?

ely enough, the proposition of y fine wire gauges does not apdismay speaker manufacturers It is more difficult and there- e costly, but not impractical. they seem to be very worried cture or decomposition of the

real difficulties arise from the e of those transformer func- which might hitherto have egarded as incidental to the ne of impedance transforma-

C PROBLEM

while speaker manufacturers and terminate high impedance ils, they aren't at all happy em being subject to direct curotential. In fact, for the higher "high impedance," involving fine wire, DC is definitely

it just a matter of arcing and rrent. Unbalanced DC through coil produces a magnetic force rries the voice coil from its entral position. Therefore, DC to be blocked off or else the il suspension must be offset and the speaker thereafter wircuit so that just the anticipatt of DC flows through the coil specific direction.

hought of critical, polarised certainly isn't a very appealing

hen, why not standardise on circuits, with a centre-tapped and with the DC component out?

what I can gather, speaker urers aren't very keen on ping the voice coil but that's nd of the story.

output transformer, with a agnetic circuit and, in better ctionalised winding, the balcoupling between the two the primary can be very good. al currents of the two output re therefore added magneticroduce what should be a sub- undistorted output envelope.

rther the amplifier departs from A operation, the more import- this function become.

voice coil isn't a transformer way. It normally has to be nd and some proportion of it outside the iron circuit, anyw successfully it will add the a push-pull circuit is open to ry.

en if it does so well enough, imate mechanical movement of whence can one derive feedere is not also a simultaneous electrical addition between the two output plates (or collectors, in the case of transistors)?

Well, then, having eliminated the output transformer, and its very useful "secondary" functions, are we going to demand high impedance voice coils, section-wound with maximum coupling between all sections? It begins to sound rather silly.

In valve circuits class B operation is the exception rather than the rule but, for transistors, it's the other way around. Nearly all transistor output circuits operate in a highly "overbiased" condition to make the best of collector dissipation ratings. Balance and coupling in the output circuit are therefore important but there's still another aspect to consider.

WORK ALTERNATELY

Under such conditions, only one transistor delivers substantial power at a time, during alternate half-cycles and each into its own half of the load. At all times, therefore, half the voice coil winding is just so much useless wire occupying precious space in the air gap.

As a result, there is a fundamental loss of efficiency in the system which puts it at an immediate disadvantage.

Having said all this, the case for high impedance voice coils looks a lot less attractive than might appear at first glance.

Conventional circuitry, involving a DC component, would necessitate either a special speaker construction or an isolating choke and capacitor. If the latter, then one may as well use a transformer and be done with it.

Push-pull systems would involve a centre-tapped voice coil, about which manufacturers are wary, while presenting the aforementioned problems of balance and the effective use of feedback.

These problems may not be insuperable and thoroughly practical arrangements may well be evolved, even in the next few months. Only time will tell.

UNTAPPED LOAD

In the meantime, a couple of new circuit approaches have been developed with valves and transistors, whereby the output of a pair is combined into a single untapped load. If we are prepared to drop more popular or more convenient circuits in their favour, then the high impedance voice coil approach may be widely adopted using such methods.

Once again time will tell!

In the letter, which prompted these remarks, John Goldthorpe hasn't concerned himself with all these pros and cons, although doubtless he has quite a few definite ideas of his own.

The important point he makes is that, if the scheme is adopted, we should see to it right away that speakers are ordered and produced to the preferred value system of numbers. If they are not, we can hardly blame our children, when their turn comes, for thinking us rather stupid!

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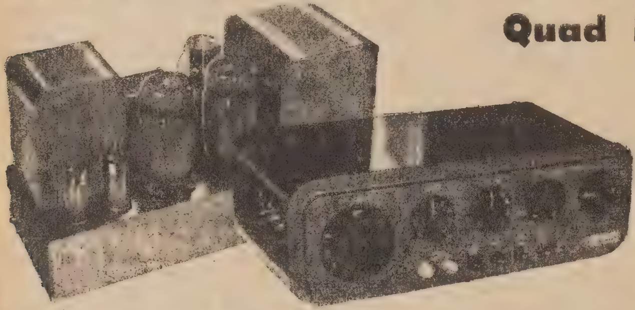

Quad II Amplifier

The acoustical Quad II amplifier and Q.C.2 control unit are generally recognised as giving the closest approach to the original sound. You should see also the Acoustical F.M. tuner which goes with the Quad II. U.R.D. also stock many other makes of amplifiers including the excellent Rogers R.D. Junior.

Ferrograph Tape Recorder

A tape recorder with the qualities of the Ferrograph should be looked upon as a long term investment. The Series 3A illustrated here is a high-fidelity instrument and has the following features: Single function switch, bass and treble controls, frequency response at 15" per sec.: 40-15,000 c/s.

Connoisseur Pick-up and Transcription Motor

These two Connoisseur units provide fine equipment for reproducing sound on disc. Pick-up downward pressure: 5 grams. Frequency range: 20 c/s to 20 Kc/s. Variable 3 speed motor with 4% variation by mechanical means.

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rks in the March issue about merit of plays, either tele- or pre-recorded on film or brought forth a rejoinder der who is currently working a cameraman.

der apparently sees my re- "contention" in favour of u of live performances, lead- tuation where our local TV ould be — or should be — pendent on "imported cellu-

omething which, in framing , I tried NOT to say. I hold r overseas film interests, and tural patriotic desire to see alent exploited to the fullest

rks were made on a purely sis, as under:

inevitable that live drama pared with cinema films, be- are here sharing a common the television screen.

drama can easily suffer by arison, because there is no for ragged scenes to be cor- emake and editing.

se of the above, it may prove actory in the long run for e directed toward pre-record- rather than the directly tele-

ALENT?

s in this a threat to local talent own standing as a camera- why?

en are still required for pre- ama — television cameramen, the pre-recording is done on than film. And actors are just either way.

ussion, insofar as I pursued it, essentially to the method of , with the suggestion that pre- echniques might allow local to be seen in better light.

espondent's further observation ntention is "strictly from the r's point of view" rather re- of the tourist's classic com- "the scenery in Switzerland od as it looks."

e whole purpose of a tele- ram is to capture the view- so that he will continue to ereafter to be educated, amus- ed as intended. He is under sion to watch the particular even to leave his set switched

AVE AUDIENCE!

tance of the program is funda- ts success, unless A.W. relish- of his video signals going to pace. Every program is a aining ground for somebody, tions can't run programs just sonnel, even if they are "real alians."

ay, in all fairness, that some drama offered since the orig- ks were made has shown a more maturity, and that must couraging to all concerned

doesn't alter the basic fact alent will either have to com- imported material on equal lse be given completely arti- dence by regulation.

one other point which I'd like I refer to A.W.'s assertion that television is a medium designed essentially to give the viewer theatre rather than a pocket-sized cinema

This looks to me like an exact parallel to the longstanding argument about gramophone records and the reproduction thereof.

Countless audio enthusiasts have based their approach to the subject on the tacit assumption that the job of record playback equipment is to transport the orchestra to the listening-room or, conversely, to transport the listener to the auditorium in which the particular work is being performed.

Many others—and our Editor is one of them — conflict sharply with this view.

BASIC LIMITATIONS

They point out that fundamental limitations of the record, amplifier and listening-room have made the illusion impossible of achievement. At the same time, however, microphone placement and electronic facilities enable a record to carry audio information which is not available to the direct listener.

This fact and the universal use of records has established them as a means of producing music in their own right and it is therefore wrong to presume that the ultimate sound should conform to or be limited by what is heard in a "typical" seat in a "typical" concert hall —if indeed there is such a thing.

Television is, I think, even more definitely a medium in its own right.

Limitations of the system, as we know it, make it impossible either to bring the stage to the viewer or the viewer to the stage. The screen size, definition and facilities are such that the pictorial emphasis cannot be on the scene as a whole but rather on close-ups and significant fragments of the whole.

This is the exact converse of the live theatre and every close-up can serve only to remind one of the fact.

The television screen and the cinema screen have rather more in common, in their content but, once again, television as we know it cannot vie with modern cinema presentation, with its wide screen, its clarity, colour and stereophonic sound.

Television is visually unimpressive, an essentially family entertainment, devoid of building or audience glamour. People watch it in their best clothes—or their pyjamas.

But the vital fact is that they watch it, or will watch it, in greater numbers than any other medium of entertainment. More and more features are being developed and produced expressly for television.

To reason that these features must conform to or be limited by the concept of a theatre stage, or a cinema, or any other medium, is plainly fatuous.

It may borrow techniques and try to recreate atmospheres for special programs but, all the time, television must go on essentially serving itself.

Am I talking down the theatre and all its associations? Am I talking down the cinema? Hoping that theatre and cinema alike will be engulfed in the tide of television? No, certainly not.

I'm merely pointing out that a new medium of entertainment has arisen on a scale which dwarfs anything which has gone before. It is quite inevitable that it will set its own standards and concepts.

A POSTSCRIPT

Having written the above and ended on what seemed to be a conclusive kind of note, I pushed the typewriter aside and turned to other matters.

Hardly had the ink dried on the paper, to use a well-worn phrase, when advance samples of stereo records and pickup arrived in the office. Ever since, the Editor has been rushing round the place with ears askew and a strangely bifocal expression on his face.

To say that he's keen about the result is an understatement but that's not why I mention it here.

I can forsee that it is going to restart the whole argument about transporting the listener acoustically to the auditorium or vice versa, because it has the potential of communicating reverberation and direction effects foreign to a monaural system.

However, it doesn't affect what I had to say about television in its present form. If and when we get large-screen, high-definition, third-dimension TV, not forgetting colour, we can start talking about transporting our audience or atmosphere visually from place to place.

Until then, what I said about television still goes.

IN DEFENCE OF LIVE TV SHOWS

Dear Sir,

I feel your contention in the March issue of using only high quality films and tapes for television in lieu of live performances, is strictly from the home viewers' point of view.

It is saddening enough to consider the present high proportion of films used in television—a medium that is essentially to give the home-viewer the theatre rather than a pocket-sized picture theatre.

Opportunities for Australian actors and actresses in the theatre and in motion pictures are, in comparison with other parts of the world, very limited. Television can be a means of discovering new talent, especially in a country as Australia where, if judging by the output of motion pictures produced, is limited to a few capable actors.

The complete use of films and tapes would mean television is reduced to the production of English and American films, for surely they are the only ones of high enough quality that you, Mr Williams, would tolerate.

Congratulations to the A.B.C. for their intention of producing more live plays and let it be an example to Australians that television is not dependent on imported celluloid.

Yours faithfully,
A. W.

P.S. Being a television cameraman I might add that the introduction of your idea everywhere would put me out of a job.

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OFF THE RECORD — NEWS & REVIEWS

One of the questions fired at me most consistently concerns the type of loudspeaker e
closure I like best. The matter most commonly in mind is bass response, for after all that
the prime reason why an enclosure is used at all. And there is no doubt that an answer
expected in terms of domestic listening.

by John Moyle

It's hard to answer such a question in a few words, for there are so many ifs and buts about it. A good many of these were considered in some detail in a couple of articles which appeared about a year ago concerning enclosure design.

I don't know of any reason to change my ideas based on the points made at that time.

You can't talk about the best enclosure, really; rather should you think of the enclosure which will give you the kind of results you are looking for.

Even more important is to choose an enclosure that suits your type of loudspeaker.

The kind of bass I like best comes from a large bass unit (15 inch variety) with a very low resonance, (round about 25 cycles), mounted in a completely enclosed box or "infinite" baffle of generous proportions. The usual advice as to size is 8-9 cubic feet and I would endorse that, even though the one I use most isn't quite as large.

SMOOTH AND CLEAN

With such a box, very sturdily made and lagged internally, I think the bass response is smoother and cleaner than with any other system suitable for domestic use. Impedance curves support this.

It is true that the back radiation is lost and the efficiency from this point of view suffers by comparison with some other types of enclosures.

But speakers of the type I have mentioned are invariably sturdy and often quite efficient, and can easily stand some extra power to make up for this loss, if indeed it should need making up.

Nor is output power really a problem with modern amplifiers.

In my opinion, the biggest source of unbalance I have noticed in domestic sound systems is too much bass. This is particularly so with users of vented enclosures and horn-loaded systems, or combinations of each method.

Properly adjusted, they are equivalent to using extra bass boost, for they increase the efficiency of a speaker system by an indeterminate amount.

But unfortunately nearly all are fundamentally afflicted with peaks and resonances which create problems for the user.

The horns are notorious efficiency raisers, particularly if they are back loaded types. Because they can produce most impressive output down to their cut-off point, their owners nearly always seem to develop a heavy bass complex which I find tiring, and often ruinous to the overall result.

HIGHER RESONANCES

But, with speakers of higher resonances, horns and vented enclosures are often the best solution. In very low resonance cones size rules them out, for appropriate dimensions related to the resonance frequency would be enormous.

Even the closed box is pretty big, but I think that is a small price to pay for a smooth response curve.

There is usually no trouble in obtaining output down to very low frequencies with such an arrangement. A suitable box might lift the cone resonance by only a few per cent, so that response should hold well as low as 30 cycles.

To approach this result from a higher resonance speaker, some enclosure reinforcement is unavoidable, and that means a coloured or peaky response.

The extra efficiency from horns isn't confined to the bass register. I have always found that horn-loaded middle and top speakers exhibit effective boost in their appropriate range, due to the increased efficiency.

It makes the matter of balance very hard to handle, because one's first
reaction to such spectacular repr
tion is to be understandably impr

But if you find yourself worried
consistently high surface noise,
hiss and the like (with an amplifier
reproach, particularly in the matt
super-sonic oscillation) you can str
suspect that you are over-doing th
works.

Where multiple speakers are co
ed, I am highly suspicious of micro
tests as a means of balancing up
ers. The complications of arranging
things in an ordinary listening roo
immense, and they have no va
taken anywhere else.

The room is a vital and integra
of any speaker system. The bette
system, the more important is the

The prime purpose of bass is n
shake the floor at all costs, nor of
to drag every triangle out into

Only your ears can tell you whe
total effect is just right, and only
long periods of careful listening
kinds of material. Even so, dif
people like different balance, alth
most eventually turn away from
tremes at either end.

EARS MUST JUDGE

Up to the loudspeaker stage, i
ments are fine. After that your
must be the final judge, but you
draw upon your commonsense,
ing experience and musical feelin
well.

My preference is for the smo
bass response at the expense of effic
if you like, and a top range whi
dispersed rather than concentrated

That's one reason I like mu
speakers, because with a varied
source one has much more flexibil
this matter.

It's not easy or desirable to c
the bass speaker, but it's not ha
balance the others.

Balance is perhaps the most imp
point of all, in my opinion.

And after all, that's what I was
for.

Long Long Players

A highly interesting news item
month concerns long playing reco
16 2/3 rpm.

Vox have released some in
with approximately an hour's p
time on each side.

I have been watching for suc
announcement for some time, for
been obvious that all recording
panies have been working on ext
playing time, with highly concen
groove spacing. Vox in particular
exploited very long playing 33
records, but they are not the
interested party.

It was only a matter of time
someone went a step further and dr
into low gear.

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as might be expected, com-
the quality isn't top grade,
y in the high registers. A
ve would be required to avoid
e loss of highs.

en stereo pick-ups arrive, and
be far away, their finer points
used to advantage.

ick-ups should have no trouble
g fine groove 16 rpm records,
et is that eventually these will

is one thing more attractive
our's music on a single disc
hours. Using a fine groove
r hours might be possible.

ht then have all Beethoven's
s on a couple of discs, with
om left for a few Overtures

ould be something that stereo
match at least within present
t could be an attractive mon-
er, and even at a considerably
ce would have many talking

discs, of course, would be
easible. American Columbia
e them for some time, to be
all places, in motor cars.
emarked before, I have some
ut no fine points to play them

ORDS OF MONTH

**NER — Overtures to
inger and Tannhauser; Tris-
Isolde, Prelude and Liebes-
yed by the Berlin Philhar-
Orchestra conducted by Her-
on Karajan. Columbia
1496.**

od indeed—hard to fault in
Both Overtures are among
t frequently played, but here
far from being routine exer-

ser, particularly, isn't easy to
nd so interesting.

istersingers I liked better, per-
use there is more in it to bite
Philharmonia plays that intricate and exhilarating final section with complete assurance and exceptional clarity.

With the volume turned well up the sound is rich and thrilling, just as it was intended to be.

But it was the Tristan side I found the best. I don't think the word magical is too fulsome for this sensitive and lovely string playing, for it is on the strings that the main responsibility lies in building both the emotional and sonic line.

Maybe Karajan is restrained, particularly in the Liebestod. I prefer it that way, for there is also a more subtle and mystical atmosphere in this closing scene which is often missed, an emergent quality which Furtwangler, particularly, was so good at building up.

You will admire, too, the way in which Karajan has judged his dynamics, how unfaltering is the way in which he moulds that wall of sound.

It's a pity the surface noise is not lower. My copy had an attack of crackles which I had hoped had disappeared from modern discs.

* * *

TCHAIKOWSKY — Excerpts from the Sleeping Beauty. Played by the London Symphony Orchestra conducted by Pierre Monteux. RCA Li6103.

This is one of RCA's most musical releases of recent months. All the best known selections from the ballet are here.

I don't know whether the English origin of the tape has anything to do with it, but the sound has much more reverberation than the average RCA made in U.S.A.

By any standards it is quite appreciable, but I thought it gave a most attractive, airy quality, not unlike many English Deccas.

The recording is rather too remote for showcase quality but the frequency range is quite good and the orchestra has a pleasant, cohesive sound.

The conductor has dealt gently with the music, but on the whole the LSO has played extremely well for him.

I liked the record best when reproduc-

PERER OUTSTANDING IN BRAHMS

**MS — Symphony No.1 in
r. Played by the Philhar-
Orchestra conducted by Otto
er. Columbia 330CX 1504.**

of Brahms Firsts is quite
. There are too many for me
ke a comparison, for I'd need
evening to hear them, and I
ether there would be much
t.

r your reactions might be to
l, it is without doubt one of
here are.

rofit and loss basis it could
the list, but I'd need more
uple of hearings to say why.

he kind of record it is. Its
d worth are evident from the

e same musicianship and lofty
which marked Klemperer's fine
symphonies recently released.
concentrated on the stature
k, and built it into great pro-
t the expense of everything else. Often I feel he becomes ponderous, and frequently I could wish for a smoother and less potent treatment of well known passages.

But his meaningful and purposeful progression is so consistent, so reasonable, and so lofty that he has little difficulty in impressing you with his point of view.

And after all, I have often sighed over performances because they failed in just those things which Klemperer has done so magnificently.

Yes, it would be foolish to consider any other version until you have rejected this one.

The sound is good, but not the Philharmonia's very best; rather dry in quality. The violins sound a little oppressive in loud passages, but its very hard to handle the heavily charged texture of this music. In the huge finale to the last movement, the recording stands up very well.

One of the month's outstanding discs.

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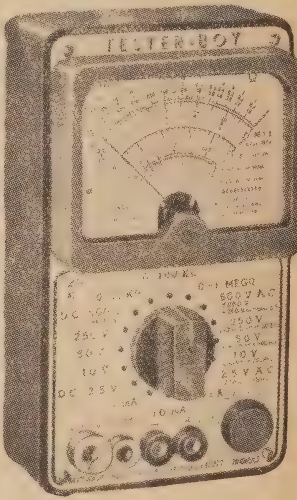

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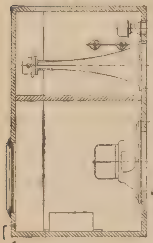
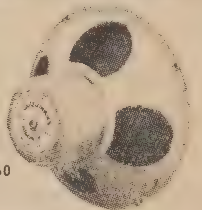
No compromises whatsoever have been adopted in the design of the Goodmans '315.' Each component is the result of exhaustive development aimed at producing an integrated system which provides the utmost accuracy of high-fidelity sound reproduction. The '315' contains three speaker units: 12" direct radiator type bass unit which operates from 30 c/s to 750 c/s; pressure-type mid-range unit operating from 750 c/s to 5 Kc/s; pressure-type treble unit operating from 5 Kc/s to 16 Kc/s. The mid-range and treble units are provided with variable constant impedance attenuators, externally operated. Network XO 750/5000.

When using the Audium 60 as the bass unit, the reproducer is known as the '315'; when using the Audium 70, the '320'; and when using the Audium 80, the '325'



The enclosure is internally divided into two parts: the upper portion containing the treble and mid-range units and their attenuators; the lower portion containing the bass unit loaded by an Acoustical Resistance Unit in the rear wall of the chamber.

AUDIUM BASS LOUDSPEAKERS



AUDIUM 60

	AUDIUM 60	*AUDIUM 70*	*AUDIUM 80*
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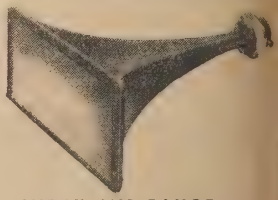
Impedance at 400 c.p.s.	15 ohms	15 ohms	15 ohms



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Impedance	15 ohms at 400 c.p.s
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volume and with an extra
bass boost.
echo can be heard, something
A should watch more care-
it could have passed with a
on had it not been for a bad
fter the final chord on side 2.
face is satisfactory although
reproach. A very safe re-
tion.

* * *

**NER—Overtures to Tann-
and the Flying Dutchman;
IUS — Valse Triste and
a. Played by the Florence
tival Orchestra conducted
orio Gui. World Records**

erest value of these items is
h on a par, so that they go
gh together. As a matter of
unlikely that they will be
larly grouped elsewhere.

ording has a somewhat muff-
about it, partly due to a
rberation content and partly
one placement.

s very much as though taken
ncert performance with most
alities of the hall acoustics.

t it sounded best when played
the original Decca curve
its lesser suppression of high-
cies gave a more acceptable

this way it is good average
hough not as good as that of
rmonia which provides several
es for comparison.

s a disagreement, too, with
the Tannhauser; The Flor-
stra, or the recording engin-
u a pitch which is raised by
i-tone.

tems, I thought Finlandia the
essful.

face is good.

* * *

**IKOWSKY—Serenade for
Opus 48; ELGAR—Intro-
and Allegro for Strings;
L BARBER—Adagio for
Played by the Strings of
ston Symphony Orchestra
ed by Charles Munch. RCA**

agio is very good—a lovely
and quite a surprise if you
all American music is made
oises and strange harmonies.

gar is the least successful.
I feel that he is on the wrong
Atlantic — I don't think I
heard his music played with
ing by any but an English
And because he was so
nd Edwardian English at that,
rprising.

achine-like precision of the
ings just isn't flexible enough,
cope with the considerable
shade which makes the music.

there enough reverberation in
remove a hard-driven atmos-

be of sound isn't so merciless
aikowsky, but there are long
here its forward and unvary-
ence becomes monotonous.
lity has to be well-nigh perfect
such close proximity.

s a trace of hum in the
and the surface noise, although
low, is mostly lost in the
g amplitude.

The Adagio has a lower recording level than the remainder.

Plays best with some bass reinforcement.

* * *

GRIEG—Lyric Suite Opus 54; Norwegian Dances Opus 35; Wedding Day Opus 65 No. 6; Holberg Suite Opus 40. Played by the Bamberg Symphony Orchestra conducted by Edouard van Remoortel. Vox APL-9840.

Grieg's charm is something unique in music. Rarely did he reach moments of great stature or profundity.

On the other hand the simplest of his ideas are rarely banal or uninteresting, despite the fact that his most frequently repeated devices are of the simplest nature, such as a run down the scale against a melodic and-or harmonic pattern.

As the label reveals, this is a mighty lot of Grieg on one disc, including two of his best Suites (both long favourites of mine) which alone would be worth the money.

I could be rather critical and suggest that in the Air of the Holberg the orchestra is over elaborate, or that in the Rigaudon both cello and violin have shortcomings.

Occasionally the orchestra betrays the fact that it isn't quite top class, but mostly the strings do their part smoothly and flexibly, with that peculiar sense of romantic grace which Grieg requires.

The recording chamber has more reverberation than average, but I think this has turned out as an asset.

The surface is very quiet. A faint trace of echo can be heard due to close grooving. Mostly it will be missed, but in the Dances there is one bad example.

RAVEL.—Gaspard de la Nuit; PROKOFIEFF.—Visions Fugitives. Played by Andre Tchaikowsky, pianist. RCA L16096.

SCHUBERT.—Wanderer Fantasy, PROKOFIEFF — Sonatas Nos. 2 and 3. Played by Gary Graffman, pianist. RCA L16102.

Both pianists are apparently recording here for the first time, and their brilliant display augurs well for future success.

Tchaikowsy is a pianist of very rare talent. Technically, he appears to be faultless. He plays not merely with dexterity and speed, but with perfectly proportioned timing and great sensitivity.

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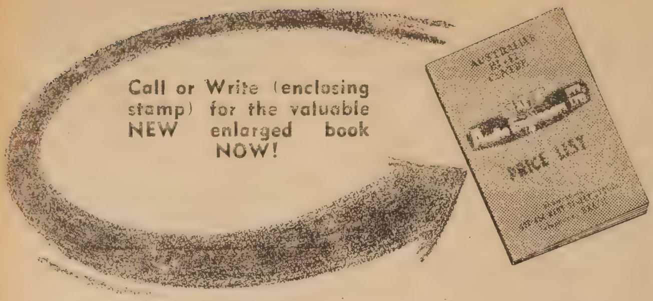

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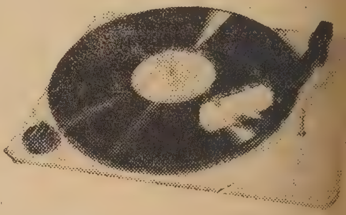

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play, too, with considerable this record shows him best nts of exquisite and crystal

to this considerable compe- otable musicianship. He has to project beyond the key- h a youthful vitality and a of co-ordination.

two discs, he has the better , recorded at modest quarters a slight tendency to break on nal peak. The bottom end ittle tubby.

n I judge to be a somewhat ype of pianist, a virtuoso in n American manner in which s, lightning attack, and high e become almost a way of

isc he reminded me in many atchen, although I doubt whe- Katchen would have attacked rt with such vicious force.

e on the jacket says that Schu- it for brilliance of effect on ce in a concert hall, rather affectionate communication nds.

y be so, but it shouldn't be

reason, if no other, I liked eff best.

this impression might be the recording, which produces no. But I think Graffman it; the tone flattens out com- er his full assault.

that further recordings are eveal a good deal more of both are worth watching. c has a completely quiet sur- softer passages.

ENBACH.—La Vie Pari- tar cast, Grand Orchestra, Alix Choir conducted by Cariven. Philips P77107L.

at this record was a Grand sque winner, probably in the section, and I don't begrudge

recording viewpoint it is out-

f course a humorous and disreputable opera, appropri- ul if not considered worthy in standard works on opera famous Kobbe.

o an only recording, as far although Coronet have a fine sienne ballet disc in which is music appears.

the tunes will be familiar to

s quality, listen to the vivid all vocal parts, including the

is their enunciation that they y word perfect, that is, our French is fast enough to high speed.

use the surface is so quiet, lmost hang on the air.

balanced and suitably placed s a genuine hi-fi sound to it, being located skilfully by reverberation.

e voices, I always imagine singers have a sharpness not to my ear. For better or for microphone hasn't removed it, and I found their impact lessened by dampening them a little.

But I certainly couldn't complain about the enthusiasm of the cast, or the deftness with which they handled the fast work of the text.

I'll add my five stars to its honours. It's a beauty.

TCHAIKOVSKY—Waltz of the Flowers from Nutcracker Suite; PONCHIELLI — Dance of the Hours. Played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Coronet KGC 109.

FERDE GROFE—Sunrise; On The Trail from Grand Canyon Suite. Played by Andre Kostelanetz and Orchestra. Coronet KGC 111.

TCHAIKOVSKY — Overture 1812. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KGC 110.
ROSSINI—William Tell Overture. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KGC 112.

KABALEVSKY — The Comedians; KHATCHATURIAN — Gayneh Ballet Suite. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KG3 113.

BRUCH—Adagio from Concerto No. 1; LALO—Rondo from Symphonie Espagnole. Played by Isaac Stern and the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KGC 114.

HUMPERDINK—Excerpts from Hansel and Gretel. Soloists and Chorus and Orchestra of New York Metropolitan Opera conducted by Max Rudolph. Coronet KGC 115.
BACH—Toccata in D minor played on the organ of St. Jacobi Kirche, Hamburg (1516). Toccata and Fugue in D minor, played on the organ of the Festival Hall, London (1954) by E. Power Biggs. Coronet KGC 116.

A month or two ago I reviewed some new Coronet discs similar in size to the standard 45s, but recorded at 33 r.p.m., and containing "Gems from the Classics"—actually dubbings from sections of already successful Coronet records.

My main point of criticism at the time was that the sound had suffered in the transfer process, and couldn't compare with that of the original.

No such criticism can be levelled at this second batch, for the picture is completely different.

They are now made directly from the original tapes, and a comparison in several instances with the full-sized discs showed very little difference.

The sound is now quite comparable with the best to be found on competitive 45s, and in some cases it is even better.

In all cases the cutting amplitude is very high—decidedly higher than in the original masters. This may have been done to improve the signal to surface noise ratio, which it does, although I don't think the recording engineers have left themselves much to spare. This will worry only the super critical, as will a slight falling off in quality at the end of a long side.

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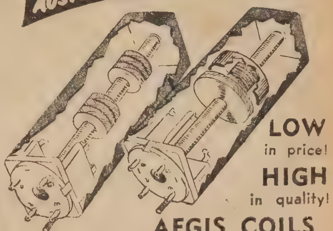

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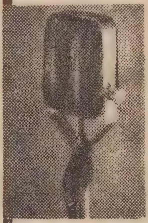

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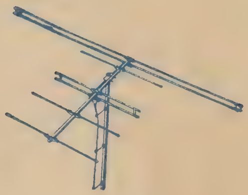

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will not invite unfavourable
as if they keep up this stan-

is too even for me to pick and
I was very interested in the
ord for its recording of the
all organ.
ked them all.

* * *

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Angeles with the orchestra
Rome Opera House conduct-
Guiseppe Morelli. H.M.V.
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h perfect singing by one of
est sopranos. Her voice is a
st for the music, but not for
n any case her artistry is equal

these two arias are among the
tiful for soprano in all operas.

* * *

**s and Music of the R.C.A.
ic Synthesiser. R.C.A. Ex-
tal Record L16101.**

was in U.S.A. two years ago, I
e Princeton Laboratories of
There, among other things, I
Electronic Music Synthesiser
Harry Olsen and his colleagues
ped to imitate various instru-
to create new sounds, in the
experiments into the nature of

left, they gave me a record,
this is a copy, containing an
lecture of sound analysis, and
nples of how a number of
cluding that of a complete jazz
been made up by the synthe-

to understand the significance
c, it is important to remem-
e sounds it contains were built
nically by adjusting the har-
tent, changing the attack and
e, and otherwise modifying a
until it resembled that of the
it was designed to imitate.

nges in pitch and loudness
arly made, so that the artifici-
ed instrument appeared as
yed in the normal way.

cess is quite different from that
Hammond organ, for instance,
there is a standard keyboard
controlling stops for a player

ever heard the sounds of the
until they were played back
rding tapes. They were not
nanipulating keyboards, but by
illators, filters, resonators and
ers.

s the process anything to do
ronic music as we know it, or
oncrete.

er employs all the gimmicks
recorder operator in playing
previous recorded sounds,
eir pitch and so on, not for-
ltiple heads and echo effects.

thesiser starts from the very
and builds up the sound qual-
y by the setting of electronic

cture - demonstration, among
gs, shows exactly how it is
the instruments of the orch-
mitated, one by one, and finally
gether to produce a full band.

Naturally, there is a mechanical character to the sounds because it would have been too laborious to have built-in the subtle touches which only human hands can produce.

But you will marvel at what has been achieved if you have any appreciation at all of the difficulties which lay behind it.

The disc was not produced for entertainment, but for interest and instruction, and records the results of experiments made as early as 1953. It is possible that results are even better today, and I hope that the attempt to imitate the human voice, however miraculous, is now more convincing.

I found this record perhaps the most interesting and important of any I managed to collect in my travels, and highly commend R.C.A. for releasing it here. I did not even realise it had been cleared for sale.

* * *

BEETHOVEN.—Concerto for Piano and Orchestra No. 4 in G major Opus 58. Played by Wilhelm Kempff and the Berlin Philharmonic Orchestra, conducted by Paul van Kempen. DGG LPE 17084.

This record has the sound of a few years back, not that it's bad or unpleasant, but there is a rather dull atmosphere about it, and the inner parts aren't as clean or distinct as they would have been today.

The bass is heavy as compared with the upper registers and can do with some taming for better balance.

The piano tone is quite good although its weight against the orchestra is somewhat variable.

In the last movement, for instance, it is just right. In the first movement there are times when it is almost inaudible.

To a certain extent this is Kemff's fault, for he displays a marked tendency to vary his pace and dynamics in a manner which it is often hard to follow.

As a result, I had the feeling that the work doesn't really get going.

The cadenzas I have not heard before, and frankly I didn't think much of them. But then you might be tired of those written by Beethoven and welcome something new. As there is no mention of their origin on the jacket, I presume Kempff exercised his pianist's privilege and write them himself.

Although I can't award a top place, there are many nice points to this disc. Not the least is that it's complete on a 10-incher.

And the surface is extremely quiet.

* * *

BRAHMS.—Sextet No. 1 in B flat major Opus 18. Played by Isaac Stern, Alexander Schneider violins); Milton Katims, Milton Thomas (violas); Pablo Casals, Madeleine Foley (cellos). Coronet KLC643.

Most composers wrote some works for unusual combinations of instruments —some of them up to nine or ten. Quite often they were intended for use by a certain group of the composer's friends, or one which had gained fame.

Many such compositions are rarely played, very largely because it is generally difficult to collect enough performers of high standard and congenial tastes, and then almost never for public performance.

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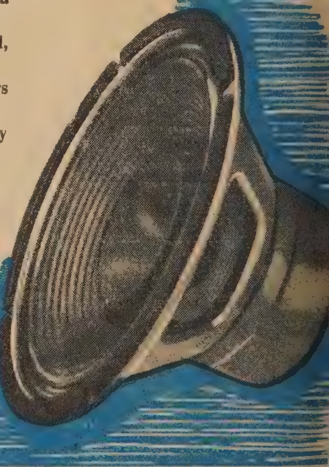

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herefore interesting for two ons—the unusual one of per- at all, and the high standard yers.

non with many others, I have d the music before, which rthwhile comment difficult. uld be pretty heavy going in rs. and I often think he was s much with his experiments s music.

think doesn't matter much, as o buys this disc will do so cial interest, and I don't imag- be disappointed.

the Prades records haven't lass but I have no particular s about this one. Engineers a worthy job of balancing and the instrumental playing e expected is very good in-

ace is inaudible.

★ ★ ★

A LA ESPANOLA. -Brazilian Sleigh Bells. NA — Andalucia, Mala- GRANADOS — Goyescas: zo; BENJAMIN—Jamai- umba; FERNANDEZ — REXIDOR — Amparito ALLA—Fire Dance; TUR- llfighter's Prayer; GUARI- azilian Dance. Played by tman-Rochester Pops Or- conducted by Frederick Mercury MG50144.

deal of Espanola on a single ll of it good. This isn't shat- h-fi, but the balance is very r all that. It has considerable , which is one of its attrac- ixes the well-known with the and the unusual, and all of npetently played.

★ ★ ★

IN — 'Les Sylphides; OWSKY—Sleeping Beauty Played by the Philadel- hestra conducted by Eugene . Coronet KLC641.

eping Beauty" I would pick modern recording than "Syl- -it could be by a couple of

good, indeed — very clean, stalline in its quality, but it rilliant background of "Sleep- " or the opportunity of scin-

far more body and presence aikowsky, which I would al- n the same class as the "Swan tioned last month — almost, te. It could have been made same time, but let me split y that the balance isn't quite

t annoyed me — the break e various sections on both too long. When listening to omogenous in quality, there is or more than the smallest doubt whether many people o use the identifying bands e the delay, but I know that curse their presence. one for everybody's list.

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SHORT-WAVE NOTES BY ART CUSHE

TAIWAN ADDS ADDITIONAL FREQUENCIES

Broadcasts from Taiwan are now carried on additional frequencies in the Home Service, and news has been received on the extension of the Overseas broadcasts.

THE broadcasts from the Voice of Free China radiated from Taipeh in Taiwan are featured this month with information on the local programs which are frequently heard here. The overseas service from Taiwan has been reported in the transmission at 8.05 p.m. when they commence the broadcast in English. This program is carried on 7235, 9573, 11815 and 15345 Kc. The frequency of 7130 Kc was recently replaced by the 7235 Kc channel.

Appreciation for the many reports received from listeners in the South Pacific was recently shown by Taiwan who plan to also beam the program at 8.05 p.m. to this area as well as Japan and Korea, when suitable frequencies are found. This information was contained in a letter from George Liu, editor of Voice of Free China. Appreciation for an interesting and accurate report was expressed in a verification letter. As the station is trying constantly to improve the program, any suggestions from listeners are appreciated.

The Broadcasting Corporation of China, which raidates programs from Taiwan, is at present broadcasting its Home Service on a variety of frequencies.

Transmissions are now as follow:

3215 Kc, Taipeh, 1; BED59, 8.00 a.m.-4.00 p.m., 7.00 p.m.-2.30 a.m. 5980 Kc, BED29, Taipeh, 2, 3. Second program is 12.55 p.m.-2.30 a.m. Third program 8.00 a.m.-10.00 a.m., 1.00-3.30 p.m.

4150 Kc, Taichung, 2; BED44, 8.00 a.m.-9.30 a.m., 1.50 p.m.-2.00 a.m. Broadcasts to Chinese mainland are carried 7.55 a.m.-11.05 a.m., 1.55 p.m.-4.00 p.m. and 7.50 p.m.-4.05 a.m. on 9555, 9685, 11730, 11970, 15280 and 15370 Kc. The calls of these stations are BED35 (9555), BED36 (9685), BED39 (11730), BED37 (11970), BED34 (15280), and BED38 (15370). These are several new stations now operating. BED22 in Taipeh on 7280 Kc broadcasts at 8.00-10.30 a.m., 1.30-5.00 p.m. and 7.30 p.m.-2.00 a.m., and BEC25, Hualien, on 7270 Kc, 8.00-11.00 a.m., 1.30-4.30 p.m. and 7.30 p.m.-2.00 a.m. Others new to the shortwave fields are You Shih (Young Lion) Broadcasting Station, BEG23, on 7180 Kc, 8.30-11.00 a.m., 1:30-4.00 p.m. and 7:30 p.m.-3.00 a.m. Fu-Hsing Rehabilitation Broadasting Station on 3375 Kc, 755 a.m.-12.05 p.m., 1.50-5.05 p.m. and 7.50 p.m.-2.50 a.m.

New Iquitos stations

THE Peruvian city of Iquitos has been heard with two new stations in the 31-metre band during the afternoons. Radio Atlantida, which has the call sign of OAX8K, operates on 9625 Kc, and has been heard to closing at 3.00 p.m., with some interference from nearby stations. The station has at times remained on the air as late as 3.30 p.m., and a report to the station has resulted in one listener receiving a vertification in less than a month.

The station is located at S. Martin 125 in Iquitos, Peru. Broadcasts from Radio Larica have been heard on 9595 Kc, from after 2.00 p.m. to closing at 2.35 p.m. The station suffers interference from Hilersum on 9590 to 2.00 p.m., after which it is heard clearly, with broadcasts also radiated from Iquitos.

ZYR on 9635Kc

THE number of signals from Brazil are such that a month hardly goes past without the hearing of a new call.

ZYR83, which operates on 9635 Kc, is a little away from the usual stations, as this one broadcasts religious programs. The station opens at 8.00 p.m., giving the call and location. Then follows the playing of "Ave Maria" and for the next 15 minutes a religious program is presented. The session is closed with the same theme music and at 8.15 p.m., after further identification, the station commencies its normal musical program.

ZYR83 uses the slogan Radio Aparecida and broadcasts rom this city in Brazil. The mailing address is Praca N.S. Aparecida, No. 315, Aparacida.

The signal is strong to 8.20 p.m. at which time the Seoul station on 9640 Kc commences broadcasting and this severely interferes with the Brazilian station.

Cotonou on 4900Kc

THE recent change of frequency of Radio Cononou in Dahomey, French West Africa, from 4870 to 4900 Kc, has resulted in improved reception. The station, which opens with the French Anthem usually, is received at fair strength. Some Morse interference from Radio Ghana on nearby 4910 Kc causes some trouble. Radio Cotonou uses 4,000 watts and can also be heard in the morning transmission. The full schedule is 3.45 to 6.00 p.m., 9.15 to 10.15 p.m. and 4.00 to 8.45 a.m. The station director is M. Rene Weill, and the address is Radio Cotonou at Cotonou in Dahomey, French West Africa.

TOKYO, in its transmission to India, Pakistan, and Ceylon, is using the new frequency of 11780 Kc, and this transmission is well received on this frequency. The transmission, which opens at 1.30 a.m., has the usual identification, and after broadcasts to India reverts to English at 1.45 a.m. The call sign of JOA25 is assigned to this frequency, and JOB21 in the same program uses 15325 Kc.

FEBC to 50 Kw

THE Far East Broadcasting Company in Manila is at present working on the installation of a new 50 Kw transmitter, reports Australian Norman Blake, who is electronic co-ordinator at FEBC.

The new installations are at Bocaue, the site of the antenna farm and new transmitter buildings.

The new antenna towers of 400ft will be erected before June, when the rainy season commences. Four of the towers are in place and work is proceeding on the guying of the masts. Work on the concrete base and guy bases is proceeding, and when the foundations are completed five more masts will be erected.

The antenna systems will be rigged later this year. They will be single and double extended lazy "H" types. Some have reflectors for one-way transmission, and others have no reflectors to allow bi-directional transmission.

This year only the beams on North-South and West will be finished, and later North-West and South-East curtains will be put into action.

Transmission lines of some 12,000ft will carry the signal from the transmitters. The 2 Kw and 10 Kw transmitters at present in use will be moved in early 1959 to this site and will be used alternatively with the 50 Kw station. When finished there will be two programs broadcast at one time. Two different areas, and larger blocks of time, will be in a single language. More English will be used for the increased schedule to provide alternate listening.

The new 100 Kw transmitter for Okinawa has not yet been commenced as the design of the building is not yet completed. This station will not be commenced until 1959, and, like the Manila station, will be devoted to Gospel broadcasting.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

AUSTRALIAN DXERS CALLING

THE popular session of dx tips from Radio Australia in Melbourne is on its winter schedule, and the session can be heard as follows:

SUNDAY 5.15 p.m. on 11710 Kc for New Zealand-Europe. 11.30 p.m. for North America, East Coast.

MONDAY 2.00 a.m. on 11810 Kc North America, West Coast. Also to Asia on 11710, 9580, 7220.

SUNDAY 3.30 p.m. on 15200 Kc to South Africa.

SUNDAY 8.00 a.m. on 15240 Kc to North Pacific Islands.

FLASHES FRO
EVERYWHE

CANADIAN station CKUS has bee
by Kevin Dunham, of Narrandera,
15105 Kc, with transmissions to the
CKUS is tuned when commencing tra
7.45 a.m. The station identifies in
French. Programs in French follow to
when the program reverts to English
quency is subject to some interfer
nearby stations, with the B.B.C on
and Lisbon on 15100 Kc, being the
which cause the interference. Montre
is also heard on CKNC on 17820
broadcasts the same program.

MEXICAN station XEXF, broadca
Leon, has been heard at fair signal l
off at 4.00 p.m. on 9535 Kc. The st
the programs of Radiodifusora Mexico
when closing, used the tune "Over
as the theme.

The station is best heard from 3.
shortly before 4.00 p.m. on Sunday
frequency is clear, of Berne, Switzer
is using this frequency before and
times.

BRAZILIAN ZYZ8, with broadcasts
de Janeiro, transmits throughout the
Sunday, and is heard in this area at
ZYZ8 operates on 9610 Kc, and w
ZYC8. The station suffers from side
from Tangier-9 operating on 9615 K
music is featured in the program, and
Radio Tamanio is frequently given.

DJAKARTA has recently been obs
transmission to Australia and New
the new frequency of 11720 Kc, w
chain with the outlet on 9710 Kc.
the Indonesian station has used th
frequency of 4910 at 9.00 p.m. in
broadcast to this area, but this has
successful channel, because of the
from the Brisbane station on 4920 K
11720 Kc transmissions are subjecte
ference from the Singapore relay sta
B.B.C., as the British Far Eastern s
present using 11725 Kc at this hour

VATICAN has put into service tw
metre frequencies, according to a
report. The new channels are heard
and 17735 Kc, and give good results

NIGER, which has recently been
installing a new 4000-watt transmitt
expected to put this station into o
September, and to use the frequency
It is expected that preliminary tests w
ducted before this date, when the
be the new radio voice of this area
West Africa.

Radio Naime will be put into ser
schedule which at the present is
tained with tests to find the best lis
for the population.

CANADIAN station VE9AI, broadc
Edmonton in Alberta, has again made
ance in the late evenings. Last wi
tion, which operates on 9540 Kc, w
and the power of the transmitter w
20 watts. Reception is again good
ing at 11.00 p.m. This commercial
is usually received at fair readability
laying the breakfast session of its m
relay CJCA.

ARGENTINE is the location of
Belgrano, which opens at 7.45 p.m.
The Buenos Aires station has typical
and frequent commercial announcemen
p.m. a further station in this city,
Splendid, on 5985 Kc, also opens t

BAGDAD is reported from Europ
good signals on 6188 Kc, and 7180
extended schedule to 11.00 a.m. Th
further reported in the afternoons o
from opening at 2.30 p.m. Broadc
new high powered transmitter of R
located in the Irak capital.

VATICAN Radio, with broadcasts
Brazil on 17840 and 11685 Kc, have
in Europe from 9.00 a.m. It has a
ported that tests on 9646 Kc from
has also provided good signals, stat
listener.

NORWAY is using two very low-p
mitters in experimental broadcasts o
6130 Kc. A vertification for a re
signals of LLA, when using the
quency, states the transmission is
and that only 100 watts is used
quency, all other frequencies on the
hour using 100,000-watt transmitters
from the station also discloses that
on 30 watts on 6130 Kc, also on an
basis, except for the period 11.00
a.m., when higher power is fed on
quency.

E HAM BANDS WITH BILL MOORE

adio Amateur Population of the world is growing steadily and from figures available
countries show high yearly increases. The annual influx of new amateurs in the U.S.A.
mated to be 12,000 due in some degre e to the classes conducted by commercial organisations free of charge.

ON carried out by radio clubs and
s the usual method by which in-
urs acquire the know-how to obtain
t times individual amateurs provide
guidance.
ding feature of the tremendous
e radio amateur population in the
contribution of a large number of
dio firms who provide facilities for

s, especially for the beginner, are
the lunch hour or after normal
s. Novice licences are reasonably
and instruction is generally directed
nes.
number of firms provide general
xamination instruction. Some typical
he facilities available are as follow:
Orange Radio Distributing Co. con-
urses of 10 weeks' duration each

vices, ages running from eight years
acquired their licences as a result
tion.
k courses are run every 12 months
Radio Corporation. Approximately
are in each class; 75 per cent com-
rse and 95 per cent of these are
he examination. The company sup-
.R.L. Licence Manual and a Code
of charge to all students.

retailing firm in Memphis has a
le practice service. Anyone inter-
ning code practice can call in dur-
hours. Practice receiving is avail-
vice or advance speed tapes and a
lator is on hand for sending prac-

sson weekly course, aimed at the
e, is conducted during the evening.
o Laboratories go even further with
scheme and co-operate with local
n programs.

youth groups, such as the Boy
.M.C.A. members, to participate in
they hold each year.
ducted by the Valley Electronics
California, over three years, have
eir students become novice licencees.
hese and many other contributions
er the American amateur population
ace.
lities could be provided by radio
country.
organisations find that employees
field who are enthusiastic amateurs
interest in their work. Organisa-
to assist would be performing a
and could also gain some advan-
ch a scheme.

Praise for amateurs

PRESS cables received in Sydney early in May praised the work of Australian radio amateurs for their co-operation in observing signals from the American satellites during their orbits over Australia.

Australian moon-watching teams were also praised in a release that covered technical data on the operating of satellites Alpha, Beta and Gamma. The Americans anticipate launching a satellite each month after the completion of the I.G.Y.

The observing team, VK2WH, VK2DR and VK2ANF, are still checking a number of orbits each day with Alpha appearing in the morning, Gamma in the evening, and Beta around midnight.

The question of power

WILFRED HILL, ex-G5WI, now a resident of the West Coast of U.S.A., from experience gives an interesting review of QRO and its problems in a letter to the R.S.G.B. Bulletin.

The subject of QRO in countries only permitting low power operation is often debated. Many radio amateurs in these countries vigorously support the granting of higher power. To offset this fact, a number of W. stations would like to see a reduction of the 1 Kw power permitted in the U.S.A.

Wilfred makes the following points against high power for amateur operation:—

The chaos caused on amateur bands by the use (and misuse) of QRO facilities must be heard to be believed. 1 Kw transmitters will block the most modern and selective receiver over considerable distances.

The conditions caused by power-happy operators striving for supremacy chasing rare DX and so carving channels in the HF bands are fantastic.

The bedlam caused by teenage operators with QRO facilities and the selfish use of 1 Kw transmitters to yarn across the town are additional features that must turn serious-minded operators away from QRO.

He also states the 1 Kw licensed input is at times exceeded by a few of the irresponsible licencees, causing even greater QRM problems.

Wilfred expressed the view that many amateurs of good standing are in favour of an all-round reduction in maximum power.

They consider that the maximum input permitted should be around the 250-watt level and that power requirements be strictly policed.

The QRP versus QRO argument will always be with us while ever amateurs have sufficient interest in the movement to foster debate.

Amateur conferences W.I.A. news

AS a forerunner to the I.T.U. conference to be held next year, National Amateur Radio Societies in Europe will hold a Region 1 I.A.R.U. conference in July in Germany.

Already most national societies have been in contact with their own licensing authorities and propounded their views on amateur frequency allocations.

The conference in Germany will provide an opportunity to compare the reception received to their suggestions. Societies will be able to prepare a specific plan of action for Region 1 representatives at Geneva.

The prospects of retaining frequencies at Geneva are being discussed at length by amateurs throughout the world. Most nations have been working on their frequency allocation plans for submission at Geneva and some 80 different countries will be represented at the conference.

Currently there is plenty of gloom being spread on amateur bands concerning our prospects of retaining amateur frequency allocations. It is all rather premature: as far as is known no nation has formulated concrete proposals.

The A.R.R.L. paints a brighter picture when they state they think the eventual U.S. proposals for the conference will be pretty fair to amateur radio. The league has been participating in the discussions to date.

The U.S.A. and British Commonwealth nations from past experience at I.T.U. conferences have proved to be the most ardent supporters of amateur radio.

Frequency planning

A GOVERNMENT committee for frequency planning has been set up in the U.K. by the G.P.O.

Terms of reference are as follow:—"To advise the Postmaster-General on the broad aspects of radio frequency planning with a view to the efficient use of the radio frequency spectrum and economic development of equipment for that purpose by the radio industry."

The members of the committee represent the radio industry, user organisations and Government departments.

John Clarricoats, G6CL, secretary of the Radio Society of Great Britain, will be acting for amateur radio on the committee.

Record sunspot activity

IN the year 1957 sunspot activity was the highest ever recorded since data gathering was first commenced in 1778.

At the beginning of this year the level was so high it was thought the peak had been reached but the count is still rising. The peak, however, cannot be far away.

The next two years should see extremely high levels of sunspot activity with propagation conditions excellent on all the HF and lower VHF bands.

During 1957 sunspots were of sufficient magnitude to affect radio communication on nearly 60 occasions, 21 of these causing major disturbances. Most of the latter occurred during June and September, a period when shortwave communication was particularly unreliable.

May and June are predicted to see the MUF well down in South-Eastern Australia and it is hoped that paths are available to areas enjoying similar conditions.

It is their hope that some of the VK2/VK3 VHF enthusiasts may emulate the feats of the VK4s earlier this year on the 50 Mcs. So far in this DX working session stations in South-Eastern Australia have only worked with JAs. They have spent many hours listening and deserve some reward for their patience.

Lecturer at the May meeting of the N.S.W. VHF section was President Jim Cummings, VK2PM, who lectured on map and compass. In view of the regular field events that are conducted, a very important subject. Jim is well versed in such matters.

RD MEMBERSHIP IN N.S.W. DIVISION

ding feature of N.S.W. Division's
ral meeting was the fact that 49
were elected, an all-time high in
the division. The membership now

the meeting was Ken Pincott,
nical Editor of "Amateur Radio."
the problems of the Magazine
entirely voluntary body.
valuable information on how ama-
ssist their magazine.
lso offered suggestions that Ken
would relay to Melbourne.
ions held in N.S.W. saw the fol-
members elected to official posi-

ent of the N.S.W. VHF and TV
Cummings, VK2PM, while the past
Winch, VK2OA, is now vice-
etary Les Cook, VK2ZAQ, and the
embers comprise Dave Andrews,
lan Hennesey, VK2ZAL, and Jim
ZCW.
l meeting of the S.W.L. section,
on, elected the following officers:
B. J. Smyth, of Strathfield; vice-
J. H. Dawson and Mr R. Luther.
B. Cartwright; assistant-secretary,
SL officer, Mr D. O'Dea.
eting 25 N.S.W. W.I.A. numbers
and country members can obtain
by writing direct to the secretary,
W. Division, Box 1734, G.P.O.,

Country SWLs can obtain official numbers by first joining the division. Associate membership is available to listeners at a cost of 25/- and on being elected to membership in the division, numbers will be issued. Write the secretary at the above address.

Incoming and outgoing cards will be handled by a listener's QSL bureau in the same manner as the State bureau. David O'Dea, the section's QSL bureau, will be responsible for its operation.

First 50 Mc W.A.C. award was finally presented to Paul Boberg, W6BAZ. The six confirmations submitted all showed S9 signal reports—you could not better that on any band.

The special trophy (see May issue) for the first accomplished W.A.C. on 50 Mcs was won as anticipated by K6GDI, who finally resolved his QSL problems.

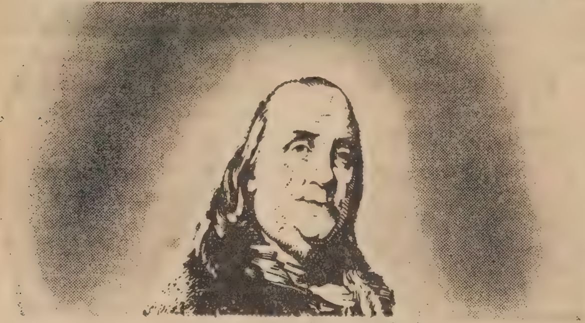
Quite a number of special 50 Mc W.A.C. certificates have now been granted to stations in W6, W9 and W zero.

These 50 Mc W.A.C.s would not have become a reality had not several European countries permitted their amateurs to operate on the band during the I.G.Y.

In view of the excellent work performed on 50 Mcs, and that next year might even provide better VHF propagation conditions, moves will possibly be made to ask for the use of the 50 Mc band until these frequencies are required for TV transmissions.

After the excitement of February and March, April was rather quiet on the 50 Mc band.

WHAT SECRET POWER DID THIS MAN POSSESS?



Benjamin Franklin (a Rosicrucian)

Why was this man great? How does
one—man or woman—achieve great
Is it not by mastery of the powers w
ourselves?
Know the mysterious world within
Attune yourself to the wisdom of the
Grasp the inner power of your n
Learn the secrets of a full and pea
life! Benjamin Franklin—like many
learned and great men and women—w
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religious organisation) first cam
America in 1694. To-day, headquarte
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Address ....

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R.L. Century Club

none boys have nearly reached the
heir CW colleagues in the A.R.R.L.'s
Club. They have rapidly overhauled
in the past three years. In 1955
countries behind; now it is only
Chas. Mellon, W1FH, and Don
AM, are still the CW leaders with
confirmed, while Brazilian PY2CK
gnised for telephony operation.
ZL2GX, is still the leader around
ith 268 confirmed on CW
the top of the A.R.R.L.'s DXCC
station set-ups are invariably quite
ny country broadcasting stations
ased to own such equipment.

instance, has six 1 Kw RF units
ted to a common power supply
r. Don's antenna farm with its
Yagi arrays is well known.
ty is expected from the VP8 area
inter; amateurs are generally busy
bs during the long summer days.
to be operating include VP8CZ
South Shetlands, VP8AY and
Georgia. Main band in use is

nd COs will be missing from the
od. In late April they were ordered
eir equipment for the duration of
r. There have been various up-
island in recent years, but it is
since World War II that amateurs
surrender their transmitting gear.

A new award

ard, "The Award Hunters' Club,"
ailable to enthusiasts collecting the
ng certificates. It will be presented
25 awards or more with special
for greater numbers. The full de-
obtained from the honorary secre-
clamo (OH2YV), Isokaari, 4-B-30,
elsinki, Finland.

. QSL Bureau now handles in ex-
,000 cards per year. It would
arly 40 per cent of these will never

QSL Bureaus provide one of the
n the world. In few countries are
regularly to national society mem-
vailable at meetings. Most overseas
e that a stamped and addressed
made available for the returns of

rial structures

ateur aerial masts and towers and
tion in thickly populated areas are
news. Considerable opposition to
has been offered by local muni-
es on many occasions. The latest
cestershire, England, concerns the
vo simple 40-foot poles and local
e banned their erection. The matter
an appeal.
. has arranged and will pay for
tation for the amateur concerned
ient handling of such an important
itor acting is also an amateur). A
t the erection of simple poles could
ects on amateur radio activity. It
a precedent that could be used in
courts.

Tape clubs

are becoming popular overseas;
at least five in the U.S.A. One
yarn to one's friends by just re-
inutes of rag chew and receive an
nilar duration with no QRM TVI
n privacy. A number of amateurs
tapes these days.
a club a new member receives a
members together with their ad-
terests.
hen select the person you would
and mail away your tape.
ips of these ventures are akin to
teur radio. No need to stop up
edule, just record your reactions at
Blind persons are obtaining a
pleasure from membership in these

mobile operation is receiving much
U.S. W9JCI, 50 Mc, activity is
ng; he runs no fewer than 500
band from his mobile transmitter.
-element beam, he has contacted
iles away, while mobile, and 300
ationary. The modulator uses class
two 4X150As are the final tubes
an old hearse.

our Amateur Operator's
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Div. Wireless Inst. Aust.
Commence July 2, 1958.
ondence course may be
d. Write for details to:—
, Box 1734, G.P.O., Sydney.

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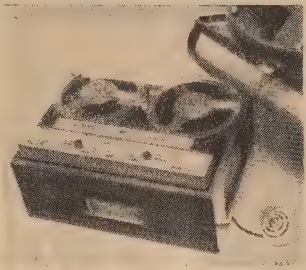

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"STUDIO"
3 Speed
3 Motor
2 or 3 Heads, single ended, 4-watt, or push-pull 10-watt. Magic-eye or Meter Level Indicator. Place-finder. Single Knob Control.

★ Simple and efficient ONE-KNOB tape Control. No spilling of tape ★ 40 second Fast Forward and Rewind ★ "Differential Brakes ★ Counter, Place-finder (Built-in) ★ Guaranteed Frequency Response ★ 1-year written guarantee.

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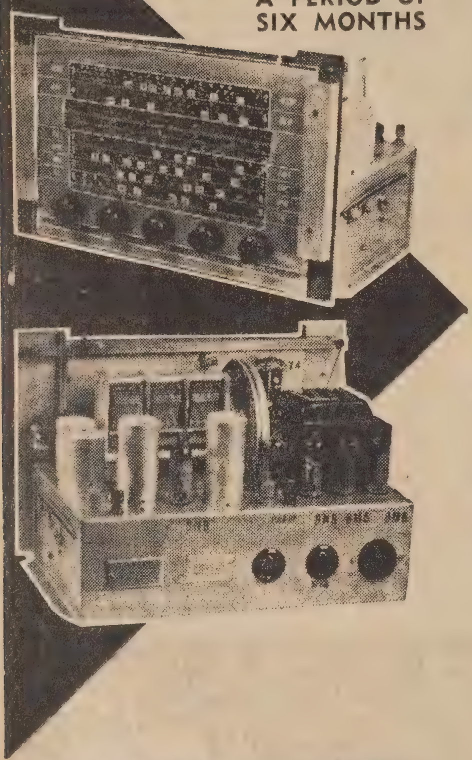

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indicator. Permatuned iron cored coils and intermediates giving excelle
state reception and a short wave range of 12,000 miles. All valves
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with separate bass and treble controls giving plus or — 15 db. boos
at 50 cycles L.F. and 10.000 H.F., combined with push-pull outp
inverse feed-back gives you really high fidelity reproduction from yo
or favourite recordings.

NEW:

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one 11in mounting hole necessary.

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each State in prominent type. Dial fitted with counterweight drive, givin
tuning. Indicator lights are fitted showing which band is in operatio
can be supplied in cream, black or brown with matching knobs and es
to suit contemporary blond or walnut finished cabinets.

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Sensitive "magic eye" tuning indicator (EM80) making tuning simple
tive even on interstate, overseas and country stations.
All chassis are wired for the fitting of an F.M. tuner or tape recorder
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Power switch is fitted to volume control, radiogram switch, combined w
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NEW SEVEN-VALVE HI-FI CHASSIS

This new compact dual wave seven-valve chassis uses the same tuner circuit as our 9-valve unit with the Mullard tone-control circuit giving separate bass and treble controls. Push-pull output using two of the new 6BM8 dual purpose output valves and heavy duty M.S.P. speaker

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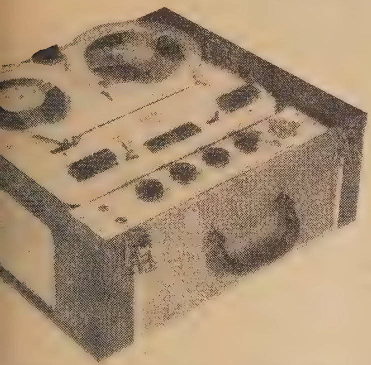
ee and hear the new Hi-Fi Recorder by Classic incorporating the ollaro Mark 111 Transcription deck. The only deck with ALL these features.



MPLETE UNIT IS SUPPLIED IN TIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE

e amplifier incorporates the latest "Mullard" er circuit equalised to C.C.R. standards giv- reproduction from recorded tapes. Record and outlet to power amplifier. Extension let and "magic eye" level indicator Ampli- letely shielded and fitted with perspex dress tch deck.

- **HIGH FIDELITY**
Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
Instantaneous changes can be made from one track to the other. Fast rewind in either direction.
- **CONSTANT TAPE TENSION**
A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
No solenoids are used in the construction of this Transcriptor The braking is entirely mechanical.
- **FINISH**
Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
3¾, 7½ and 15 inches per second.
- **FOR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Playback" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter to less than 0.15 of 1.0 per cent.
- **TWO MOTORS**
Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear

PLETE RECORDER WITH MIKE—80 GNS. f.o.r.

CK WITH AMPLIFIER, POWER SUPPLY & 6in x 9in SPEAKER 70 GNS.

ereophon

IVING SOUND—

ct 11-Valve
e Radio-
two chassis
a variable
n Tuner,
t preampli-
Tone Con-
ne unit and
Ultra-linear
Ideally
use with
e pick-ups
ers.

65 GNS.
F.O.R.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

THE PUBLIC SERVICE OF

PAPUA AND NEW GUINEA

VACANCIES

DEPARTMENT OF POSTS AND TELEGRAPH

RADIO INSPECTOR, GRADE III	**£1,693-1,873 p.a**
Qualifications:	First-class P.M.G. Commercial Operator's Certificate of Proficiency or equivalent; wide experience interference suppression investigation, conducting of P.M.G. type wireless examinations, telecommunications procedures and staff management.
Duties:	Responsible for the efficient functioning of Radio Inspection and Operating Section.
Accommodation:	Married or single available.
Location:	Port Moresby, but frequent inspection zone centres required.

SENIOR TECHNICIAN (RADIO).	**£1,258-1,318 p.a.**
Qualifications:	Qualified as P.M.G. Senior Technician (Radio) or equivalent; H.F. and V.H.F. experience; supervisory ability.
Duties:	In charge zone transmitting and receiving stations (transmitters 500 W power); V.H.F. M.F./H.F., C.W. and radio-telephone trunk and out-station services.

TECHNICIAN (RADIO).	**£1,088-1,198 p.a.**
Qualifications:	Qualified as P.M.G. Technician (Radio) or equivalent; H.F. and V.H.F. experience.
Duties:	Assist in maintenance and operation zone and out-station radio equipment.

●

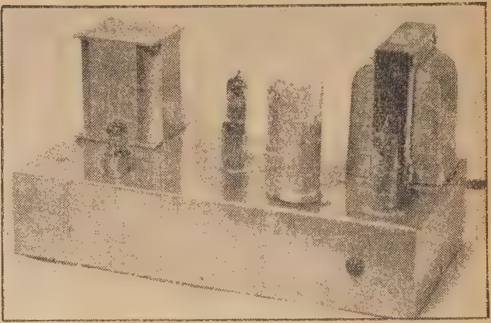
GENERAL INFORMATION

Salary:	Rates quoted are actual fo married appointees and in allowances and adjustm Married officers receive a ther £125 p.a. Additional Territorial Allo of £25 p.a. after 5 years vice and a further £25 p.a. 7 years' service is also pa
Eligibility:	Adult male British su under 45 years of age.
Appointment:	Permanent subject to satisfa probationary period.
Location:	Appointees are required to anywhere in the Territory.
Accommodation:	Except for Radio Inspector quarters only available. M accommodation not ava under 18 months from da appointment.
Separation Allowance:	Payable at discretion of tory Administration; design compensate for added exper married appointees oblige maintain family outside tory.
Leave:	Three months after 21 mon Territory. Additional months' leave after each years' service and six m furlough after 20 years' se
Taxation:	Income derived by residen Territory from sources the Territory is not at p taxable under Commonw legislation.
Further Information:	An information handbook Public Service of the Ter is available from the Depar of Territories, Canberra Sydney, or from any Com wealth Public Service Insp Commonwealth Emplo Office or official country Office. Other enquiries t partment of Territories, Can ('phone U0411, extension 2
Applications:	**Submit** on prescribed form able from offices men under "Further Informati **To** the Secretary, Departm Territories, Canberra, by June, 1958.

ADE REVIEWS AND RELEASES

V A. & R. AMPLIFIER
C-CORE TRANSFORMER

t grain oriented output transformers pro-
or sale in Australia are being made by the
company in Melbourne. We have received
le for test wired into a Mullard 5/10
, and expect to find some available soon
for Playmaster circuits.



lifier gave a most impressive
nance, largely reflected from
of the transformer.
ircuit its main resonance is
but occurs virtually at one
it, when compensated for in
rcuit of the first valve, ring-
rshoot are almost completely

no compensation across the
sistor, which may account for
ably good stability, even with
capacitive loading, despite a
25 db.
er response was again very
lly full output being obtain-
cycles to well beyond audi-

y response was flat to 50 Kc
oot it dropped 1 db. The 3
curred at about 90 Kc, 6 db
and 12 db at 200 Kc. This

☆

The amplifier chassis measures 14 x 7 inches. The new grain - orientated output transformer is on the left.

is a very nice, safe roll-off, and indicates sound design.

The amplifier shown here is built round the A and R kit set which includes the transformers and basic chassis. It is intended to be used with a separate tone control unit as designed for the 5/10.

The output transformer is no smaller than the standard types, as it uses the same case, but it is obvious that the grain orientation has allowed better characteristics.

We are most impressed by the performance of this new line.

sistor Tester is compact and efficient

cal manufacture of transistors already under way, we can
to find them used extensively from now on. The problem of
oviding a simple means for testing transistors now arises.

Y the only means of testing
istor for all important char-
s by means of a dynamic
r.
the average constructor is

Transistor - Tester

more interested in an instrument which is capable of giving a quick check. The Gossen transistor tester is such an instrument.

A particularly valuable feature is the special socket which permits new transistors with long leads to be connected in an instant. However, the omission of a simple means of connecting transistors with short leads is to be regretted.

Either PNP or NPN transistors are connected in the common emitter circuit and the current gain and standing collector measured. Current amplification factors up to 200 are measurable in two ranges while the standing collector current is measured on a 1mA scale.

The main limitation of the instrument, in common with all other relatively simple testers, is that it checks the current amplification factor at one point only.

At the same time we found the instrument extremely useful during the period it was made available to us for sorting out damaged transistors and obviously out-of-balance pairs.

The price is £30 plus sales-tax where applicable. Further information is available from Jacoby, Mitchell and Co. P./L., 469 Kent Street, Sydney

MANLEY SAFETY "FLASH-R-LAMP"

Marketed under the name Manley "Flash-R-Lamp", a new release from Amplion (A'sia) Pty. Ltd. is designed particularly to remove the hazard from night breakdowns on the road.

IN its assembled form, the lamp can be used as a portable, completely self-contained electric lantern, providing a powerful white forward beam with signalling facility and a red rear light with automatic blinker operation.

It can be carried or rested in a horizontal or vertical position, is completely waterproof and will, in fact, operate completely submerged.

A valuable feature is that the white lamp can be detached and used as a trouble light at the end of a cord, leaving the red flasher on the road as a warning.

The Flash-R-Lamp, is attractively finished and is completely unbreakable, showing no reaction even to deliberately being tossed on to a cement floor. (Amplion A/sia Pty. Ltd., 101 Pyrmont Bridge Road, Camperdown, N.S.W.)

KITSET SPECIALS

Why pay more when you can build any of these for half price.

ECONOMY 4	£9/10/-
INTERSTATE 5	£10/15/-
SKYHAWK—D/W-7	£12/15/-
CONCERT MASTER—P/P-9	£14/10/-
SKYMASTER II	£22/10/-
(4 Band-Communication)	
AMPLIFIER—10W—P/P ..	£10/5/-
AMPLIFIER—25W—P/P ..	£12/15/-
MULTIMETER KIT	£8/5/-

(R. TV and H., January, 1958)
Over 400 Built Since January.

Meter Specials

50 Microamp. (4½in. Rect.) ..	£5/-/-
100 Microamp. (4½in. Rect.) ..	£4/10/-
1 Milliamp. (4½in. Rect.)	£4/-/-
1 Milliamp. (3in. Round) ...	£3/-/-
1 Milliamp. (2½in. Sq.)	£2/10/-

Transformer Specials

400V/400V at 250 mA	£4/-/-
1,000V to 500V aside.	
M/TAP SEC. at 300 mA	£7/-/-
560V to 425V aside.	
M/TAP SEC. at 250 mA	£5/-/-

Valve Specials

5U4
5Z3
6AK5
6AG5
6AQ5
6AU6
6BL7GT
6J6
6M5
6SC7
6SJ7GT
6SK7GT
6SL7GT
12AU7
12AT7

ALL NEW AT 10/- EACH

CALL — WRITE — PHONE
For Quote on Your Requirements

ELECTRONIC DEVELOPMENTS
573 FLINDERS LANE
MELBOURNE. MB2078

Radio and Television Accessories

RADIO. We specialise in Radio Parts and stock all reliable brands including Resistors, Coils, IFs, Condensers, Speakers, Valves, Pick-ups, Changers, Players.

TELEVISION. Turret Tuners, Picture Tubes, Valves, Transformers, Deflection Kits, Video and Sound Strip, Chassis (R. and H.), Sockets and Accessories.

DRILLS AND TOOLS. Black and Decker products, Sher Drills and Kits.

SETS. Radiogram—Mantel and Portable.

ELECTRICAL. Cake Mixers, Toasters, Iron, Percolators, Vacuum Cleaners, Lawn Mowers, 2 or 3 Brush Polishers, Pressure Cookers.

SHAVERS. Diplomat, Braun, Sunbeam, Philishave.

DAVIS RADIO CO.

Wholesale Radio Distributors,
1st FLOOR, Wembley House,
841 George St., Sydney.
Phone BA3917. Open Saturday Mornings.

French Multimeter is Easy to Us

Not having had an opportunity to handle French test equip before, we were agreeably surprised at the quality and general of the "Metrix" Mod. 430 multi-range meter recently forwarde us for review by Electronic Industries Imports Pty. Ltd. of 718 ramatta Rd., Leichhardt, N.S.W.

THE instrument is based on a 0 to 50 uA meter and provides AC and DC ranges up to 5,000 volts internally and up to 30,000 volts by means of the external probe shown in the photograph. The accuracy is given by the manufacturers as 1.5 p.c. of FSD up to 1,000V on the DC ranges. The accuracies cannot be expected to be as good on the AC and higher voltage ranges but at the same time will be found to be better than required for most service work.

A built-in series capacitor permits the use of the AC ranges for measuring output voltages as required in receiver alignment while DC current ranges and resistance ranges are also included. The highest of the latter is capable of giving an indication on 20 megohms.

For general bench use, one of the most valuable features of the instrument is the overload protection system. The manufacturers describe the device as a magnetic circuit breaker. While we are not familiar with the method of operation of the device we found that it was most efficient in practice, reacting immediately and without damage to the meter in the case of deliberate heavy overloads. In most cases the meter pointer only moved tion of full scale and it would that the meter movement is indestructible by wrong setting selector switch.

The meter is fitted with a kn

pointer and an anti-parallax m assist in making readings with curacy. The layout of the scales colours and the large clear rang ting knob make the instrument ure to use on the bench.

The price is £29/10/. for th plus £8/15/- for the 30 KV where required. Both prices p

USEFUL DB CALCULATOR FROM RADIOTRON

A VERY useful Decibel Calculator is available free and post free from the Amalgamated Wireless Valve Co. Pty. Ltd., 47 York St., Sydney.

Called the "DB Rota-Guide," the calculator consists of two circular cards, held together at the centre by a tubular rivet. By rotating the front card so that an arrow points to any voltage gain figure between 1 and 1,000, the decibel figure can be read in a window.

Power ratios in DB are obtained by halving the above figure.

Despite its relative simplicity, the calculator appears to be quite accurate, and is a handy item to have on the bench.

WM. J. McLELLAN ADVERT.

OWING to a production error, the quantity details for R, TV and H "35-Watt P. A. Amplifier" were omitted from the advertisement for Wm. J. McLellan and Co. Pty Ltd. appearing in the April issue. This advertisement now appears correctly on page 74 of this issue.

BASE, COVER AND FOR EASY CONNEC

TELEVISION receiver owne appreciate a base, cover a which permit easy connection aerial when the receiver has to b either for dusting or repair.

The SA12 base is of cream p and is intended to be secured to with two countersunk wood scr has two moulded-in screw term facilitate the connection of at pads and a knock out section co-axial cable as well as 300 ohn connection in the case of mul stallations.

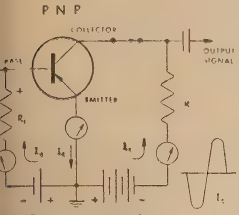
A mica filled phenolic pl cream polythene cover complete These are designed specially standard 300 ohm ribbon and the type number TA12.

The retail prices are SA12. TA12 3/1. Further informati Wm. J. McLellan and Co., 12 Street, Sydney.

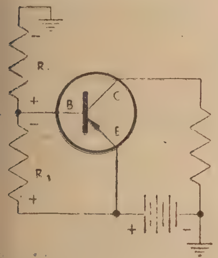
DAMENTAL TRANSISTOR THEORY

(Continued from Page 91)

adily recognisable because it
s be shown as terminated by
line. The collector is the re-
ne which does not have an
it.



28—Common emitter circuit.



—Biasing by voltage network.

the use of these symbols,
you will notice we are using
pe transistor (the emitter arrow is pointing in toward the base). Again we have forward bias applied to the base emitter circuit by means of the small battery which causes a small amount of static base emitter current.

The collector circuit is biased in reverse since the negative electrode of the larger battery is connected to the positive or P-type collector. Here again, the signal being applied to the circuit is varying a small base emitter current and thereby varying the larger collector current. The current carriers leave the emitter, enter the base region, and at least 95 per cent of them enter into the collector.

Although we have until now always provided bias by means of two batteries, in Figure 28 we can bias a transistor circuit by means of a single battery and a voltage divider network. Notice that we accomplished a reverse bias on the collector by means of the negative terminal of the battery being connected to that collector. From the positive terminal of the battery to ground we find a two resistor series network.

With this arrangement there will always be some current flow through the two resistors and the voltage developed across the resistor R2 due to this current will be the bias voltage for the emitter base circuit. Since the voltage developed across this resistor will be negative on the base side and positive on the emitter side, this voltage will bias the base emitter circuit in the forward direction. Some circuits using transistors will also use the self-bias method which is a very common system used with vacuum tubes.

ICE TODAY IS HELPING ARCHEOLOGY

(Continued from page 19)

for instance, cause corn to
and greener than elsewhere
line of corn of this nature
n the air will most certainly
filled ditch. Buried walls or
vill show up as an area of
wth of vegetation or grass be-
e difference in moisture con-
shallow earth.

ather is a time which suits
photographer very well for
rved grass growing in shal-
l over buried walls or old
ds will show up against the
ss of the surrounding area.
which have been filled in over
how up darker against the
of undisturbed soil or gravel.
rticularly noticeable in Eng-
halky areas. Many Roman
been found by this method.

PHOTOGRAPHY

method of finding filled-in
hes without the aid of aerial
y is the resistivity-surveying

sists of measuring the differ-
en the electrical resistance of
and undisturbed soil. Even
isual trace above ground is
method will discover filled-

ound a site it is desirable that
e place at a point where it
densely occupied by the an-
itant.

The procedure of "phosphate determination" does this for the archelogist. Rubbish deposited by settlement gives to the soil a higher content of phosphate than the surrounding area. Soil is taken from various parts of the site and analysed for phosphate content. That which contains the higher percentage of phosphate is almost certainly the part of the site which was more densely occupied. Excavation can then be carried out at that spot. Thus much time is saved by the excavator in searching for the most likely place in which to find relics.

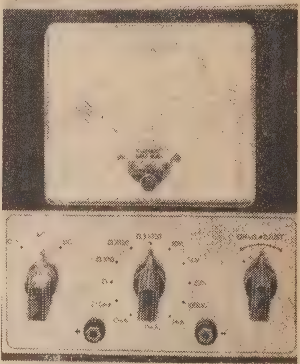
SCIENTIFIC PROCEDURE

Modern excavation is a highly scientific procedure. All the haphazard digging of former years has gone and in its place is an army of geologists, surveyors, chemists, architects, physicists, builders, photographers and so on.

The site is surveyed and plotted. Marks for excavation are laid down. Digging is carried out in a highly organised fashion so that cave-ins of the earth are avoided. When anything is found it is photographed in situ. If it is fragile special methods are used either for hardening it before removal or lifting it with its surrounding soil.

Study is made of the layer of earth in which the relic is found and methods of dating it are used as described above. The modern archeologist and the modern detective now have much in common.

TV
Brass Tuner Chassis, R. and H. type, 19/6, plus 25% tax. 1/4 postage.
AUDIO
Linear Output Push Pull Transformer, full fidelity, tapped two positions, one for beam tubes. 6V6, SC7. etc. One for penthode as EL84 EL34. Uncased. Weight approx 5¼lb
£4/5/ plus tax
Linear single output, full fidelity, tapped, 5 watts, £2/19/6, plus tax.
Instrument transformer, 240 A.C., 150V 15 mills, 4 and 6 volts, 2 amps.
£1/19/6 plus tax
Step down transformer, 3 amp, 240 A.C. to 122 V or 6V 20/. plus tax.
INSTRUMENTS
R. and H. type Multimeter. Complete as per illustration. £14/10/, plus tax. As per illustration, no batteries.



INSTRUMENT CASES
Figured front panels for R. and H. designs. Vacuum tube voltmeter, multimeter, sweep and marker generator. Oscilloscope, figured with all holes punched, black background, silver figures, 19/6, plus 12½ per cent tax, plus postage 1/4.
Standard Instrument Cases. Finish Grey.

Cat. No.	Long	High	Deep	Prices plus 12½% S.T.		
MC6	6	6	6		11	9
MC5	9	6	5		12	10
MC7	10	8	7		17	10
MC67	12	7	6		19	9
MC81	10	10	8	1	3	6
MC811	12	11	8	1	8	3
MC82	13	8	6¼	1	8	3
MC79	15	9	7	1	11	0
SLOPING FRONT CASES						
SF7	7¼	6½	6		15	3
SF79	9¼	6½	7¼		19	6
SF71	11	6½	7¼	1	2	0
SF8	13	8	8½	1	6	6
SF10	18	10	10	2	1	0
R. & H. type Cabinets, finish Grey Hammerdock, louvred sides, welded corners. Plus tax, 12½%						
MC5A	9	6⅝	5½		18	9
MC82A	13	8	6⅞	1	12	3
MC87A	15	10	8	2	2	0
Sloping Front for Multimeter.						
SF7A	7½	7¼	7¼	1	1	0

Mackinnon and Nicholls Ltd.,
468 Collins St., Melbourne
R. H. Oxford & Sons Pty. Ltd.
97 Marriott St., Redfern,
N.S.W. MX3764

NEW VALVES AT BARGAIN PRICE

1T4	10/	1Q5G	5/	6U7G	6/6	KTW62/6U7	
1S5	10/	1P5G	5/	6Y6GT	12/6	VR65A	2
3S4	10/	1C7G	5/	6X5GT	10/	CV6	
3V4	12 6	1K5G	2/6	6J79	5/	36	
1R5	12/6	6AC7	2/6	6U7G	5/	7193	
1A7GT	9/6	6C8G	7/6	6J6	15/	954	
1D8GT	9/6	6SS7	8/6	6F8G	10/6	955	1
6A8G	10/6	6F6G	9/6	6A3	15/	12A6	1
6K8G	9/6	6H6	2/6	7C7	3/6	EF50	
6SJ7GT	9/6	6H6GT	1/6	7A6	3/6	110TH	£2/
6X5GT	10/	6J7G	7/6	78	7/6	811	
12K8	10/	6K7G	3/6	71A	7/6	866/866A	1
12SK7	7/6	6K7GT	7/9	EL32	10/6	828	£1/
EK32	10/6					12SH7	
6SA7GT	9/6					12SL7	1
830B	12/6					6K7G	
6SH7	3/6					100TH	2

Please add Postage on All Valves.
SPECIAL PRICES FOR QUANTITIES.

New Power Transformers

60mA prim.: 240v with 230v tapping, Sec. 285 x 285 with 6.3v filament winding. 60mA.

27/6

Plus Postage: N.S.W., 3/6; INT., 5/3.

NEW 4in Per-Mag. Speakers

5T. or 7T. Trans., 30/-.

30/-

Post. and Packing, 3/6.

New Midget Power Trans.

40mA Prim. 250v Sec. 225 x 225 with 6.3v. Fil. Winding. Upright or Flat Mounting. Size 2in x 2½in.

25/-

2/6 Postage, N.S.W.; Interstate, 4/6.

30mA. 240v. Prim. 150 x 150v. Sec. with 6.3v. Fil. Winding.

22/6 **Postage, N.S.W., 2/6: Interstate, 3/6.**

BUILDING R. TV & H. TV SET

All Major Parts in stock, including R.C.S. IF Strips and Tuners, Valves, Power Transformers, Chassis, etc.

NEW DYNAMIC HEADPHONES

These headphones made by Rola are a high-quality unit giving excellent tone. Fitted with comfortable ear pads.

25/- **Post 4/6.**

New No. 7 HAND MICROPHONE

with Switch Dynamic Unit.

25/-, plus Post.

VALVE SPECIALS

20/- will purchase any one of the following Valve Specials.

5	1P5	3	6K8G
6	1C7	6	6SH7
5	1Q5	8	6AC7
12	1KS	5	6J7G
6	954	4	6U7G
6	6C8G	4	12A6
10	EF50	2	6X5GT
12	VR65A	7	6K7G

Post and Packing, 4/6 extra.
ALL VALVES ARE NEW.

NEW 6H6 OR 6H6GT VALVES

Individually Cartoned.

12 for 20/-

Post 2/6.

New Transmitting Valves

803	30/
100TH	£1
866	12/
811	15/
830B	12/6

New Micro-Ammeters

New Paton Micro-Ammeters

0-500 mA, 1¾in diameter. Flush mounting.

25/-

Post and Packing, 2/6.

CONDENSER SPECIAL

Boxes of 100 new mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v. paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v., 10 mfd/40v., 8 mfd/525v., 16 mfd/350v., electrolytics.

25/- **per 100.**

Post Extra: N,S.W., 2/6; Int., 3/6.

NEW VIBRATOR

A.W.A. Oak 6-volt Synchronou
base
A.W.A. 12 V Synchronous octa
7/6. Post 1/6.

NEW PUSH BUTT SWITCHES 20/-

Five pole pu
switches
New contro
fitted with
switch, also
with globes ar
contact by ke
Post: N.S.W.
Int.

NEW I.R.C. RESISTO

I.R.C. carbon resistors, ½, 1 and
in values 50 ohm, to 5 meg., in
many popular sizes, 3T, 15T
25T, 50T, 100T, 250T, 500T, e
(Standard resistor colour code su

100 for 25/-

(Plus 1/6 postage.)

New High Impedan Headphones

35/- **Po**

Telephone Generat

New small telephone generator
for bell ringing, etc.

10/6 **Postage 3/**

GERMANIUM DIOD

for that Crystal Set.
7/6. Post Free.

511A C.R. TUBE

These 12in tubes have been
mended for TV use in "Radio
Uses same sockets as VCR97.

£4/17/6 F.O

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. PHONE LM7
640 KING STREET, ST. PETERS, N.S.W. PHONE LA6

RANSCEIVER SPECIALS

No. 22 TRANSCEIVERS

ransceiver covers a frequency of 2 to 8 Mcs, and has been by the P.M.G. for use on fishing boats, small craft, bush fire etc., if converted to crystal control, for which it is easily These sets are supplied complete with valves, 12v. vibrator, pply, dynamic headphones and microphone leads.

£12/17/6 F.O.R.

No. 19 TRANSCEIVERS

These units cover a frequency of 2 to 8 Mcs. and contain 15 6.3v volt valves including 1-807, 2-6V6, 6-6K7, 2-6K8, 6B8, etc., also 500 micro-ammeter.

Units supplied complete with valves, leads, junction box, genemotor power supply and dynamic headphones and microphone operate from 12v. supply).

£7/15/- F.O.R.

PACKAGE 15/- EXTRA

No. 11 TRANSCEIVERS

complete with valves, high and low power genemotors, leads, es and microphone.

£6/15/- F.O.R.

No. 108 TRANSCEIVERS

These 6-valve Walkie-Talkies are supplied complete with valves, head-phones and microphone.

£7/15/-

PACKAGE 15/- EXTRA

RICAN HANDY TALKIE, SUPPLIED WITH VALVES BUT LESS COILS AND CRYSTALS.
TYPE BC/611, £6/15/-, POST AND PACKING 15/- EXTRA.

NEW 5 BPI C.R.O. TUBES £2/17/6

—IN ORIGINAL CARTONS—

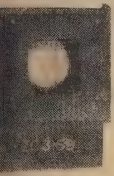
FOR THAT TV SET OR OSCILLOSCOPE

AMIC SOCKETS FOR ABOVE 4/6 EXTRA (Post and Packing Freight Rate—N.S.W. 12/6, Interstate 17/6.)

22 TRANSCEIVERS—CRYSTAL CONTROLLED

NEW CONDITION—FREQUENCY 2 TO 8 MCS.

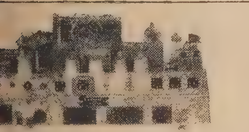
al Set for Small Ships, Fishing Boats, Fire Brigades, etc. These Sets, which are air tested and approved by the are supplied complete with 10 valves, 12v. vibrator power supply, 9in x 6in oval speaker, microphone and to required frequency. £29/15/- F.O.R.



NEW INDICATOR UNITS

These new indicator units contain 3 valves, controls, etc., and V.C.R. ACR/10 C.R.O. tube and socket. Ideal for the small scope.

£3/10/-
F.O.R.



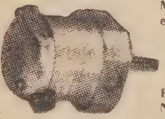
DAR RECEIVERS

ar receivers type ZC955 contain 16 a 30 Mc. I.F. strip suitable for your ment. Units are in new condition.

£2/17/6

Packing 15/- extra.

24 Volt Midget Motors Shunt Wound



Fully Laminated Fields Wound Armature Sixteen Segment Commutator, ball-bearing. Ideal for Model Trains, Hobbyists, etc. Condition new.

Price, each

25/-

Packing and postage: N.S.W., 1/6: Interstate, 2/6.

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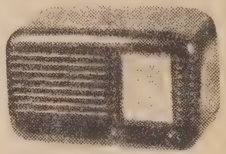

£12/17/6

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/ 12V GENEMOTORS

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£2/7/6

N.S.W., 6/6; Interstate, 9/6.

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- Rola
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- Elac
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Please send me catalogue of hi-fi equipment.

NAME ____________________

ADDRESS ____________________

RH 55

SWERS TO CORRESPONDENTS

wants to know if we have ever
tor type 3-speed record player
uld be possible to buy all the
device
er described such a unit, R.B.,
the difficulty of obtaining parts
time. The position is improv-
f the parts for the amplifier
vailable, but the problem of a
remains.

l, N.S.W.) is anxious that we
of Reflex Horns, Vented En-
ar forms of speakers, and sug-
is subject in the Answer Tom

for your suggestion, G.A., and
idea in mind for possible use
the meantime we suggest you
articles on the subject in the
r, and November, 1956, issues.
re available through our query

e Gardens, S.A.) sends us a
it which appears to be from a
nerative receiver, and wants to
suggest why it is not working

t much we can do to help,
y as we do not possess the
e portion shown appears to be
rd audio amplifier, and, with-
the nature of the fault, we
y reason why it should not
d to learn that you found the
articles so interesting.

.N.S.W.) has an AR8 receiver
the defect that 2BL is received
roadcast band. He also asks
he effect of daylight on short-

you describe is more or less
nsidering that the IF is almost
frequency, and that you are
miles of the transmitter. We
y certain cure, but the best
to shift the IF slightly until
this channel. What you say
night reception is correct, and
conditions vary from hour to
ditions you mention, the best
for it that the major portion
will be in darkness, and that
d receiving aerials favour trans-
ption in the direction which
on.

N.S.W.) asks when we intend
pletely battery-powered gramo-

ifficulty at the moment is the
battery-operated motors through
l channels. The supply posi-
is rapidly improving and we
difficulties on this score. With
to the input circuit, a tran-
ng the lines of that described
would be suitable.

Vic.) in one and the same
th a pat on the back and a
He finds fault with the Ama-
uner recently described, while
ecent articles on obtaining the
s Certificate of Proficiency as

ad and noted all your criti-
in detail. We can defend
criticism on the ground that
igned to use only components
this country and able to be
cost and with a minimum effort
constructor. For example, the
ers immediately saves most of
in trimming coils for a band-
order to give exact coverages
ck accurately. It is true that
poses some frequency standard
exact calibration when chang-
er, such a standard is desir-
the conventional arrangement.
nd remarks and best of luck
cal Engineering course.

Vic.) wants to know whether
could be used in place of the
ks some information regarding
ers and crystals.

, we have absolutely no idea
which you propose to make
making it virtually impossible
ether this is feasible or not.
valves are not really very
ubstitution is not likely to be
many cases. We assume your
opper oxide rectifier implies its
t supply, but this could also
tions. It is difficult to com-
of copper oxide rectifiers and
are normally used in quite
s and it would be necessary
ular one involved. In general,
only as detectors and are not
rectifiers in any sense.

, Vic.) is one of our younger
uilt a number of our smaller
sets, including one of the transistor sets. He wishes to know if we can supply data for a "rush box" for use on 144 Mc.

A. By a "rush box" we assume you are referring to the super-regeneraitve type of receiver. If so, we are afraid we cannot help much, since the only data we have published is for a 166 Mc receiver of this type in October, 1947. However, receivers of this type are not looked upon very favourably for use on the 144 Mc band these days, due to the severe interference they create.

P.A.O. (Highett, Vic.) is interested in an imported type of flash unit using transistors and wants to know whether we can supply any circuit details.

A. We have seen the device to which you refer and it appears to use a heavy duty power transistor as an audio oscillator in place of a vibrator. The total energy does not appear to be more than about 30 joules, although the reflector and lamp appear to make good use of this limited amount. There does not appear to be much prospect of obtaining suitable components, particularly transistors, at this stage. The unit uses a normal electrolytic capacitor.

G.E.P. (Burwood, Vic.) has recently installed an elaborate amplifier and speaker system, and wants to know if it is possible to use a tuner with it. In particular he suggests a crystal or transistor set.

A. It would be possible to use a crystal or transistor set in the manner you mention, and there is little likelihood of damage to the equipment. However, the performance of such simple receivers generally leaves much to be desired, both in terms of selectivity and freedom from distortion. The idea would be worth trying, if only because it would probably not involve much work or expense, but we think you would find a more conventional tuner a better proposition.

G.F.M. (Darlington, N.S.W.) writes to tell us of his experiences with the Three Band S/W Receiver of May, 1957. He has logged 276 broadcast stations, Australian and overseas, not counting local broadcast stations. Similar performance has been obtained on the S/W bands, including American and English stations. He also inquires about 144 and 166 Mc receivers and suggests we describe something along these lines in the near future.

A. Many thanks for the report on the receiver, and it is gratifying to learn that you have had such success with it. Your log of stations is certainly impressive and an excellent example of what can be done with simple equipment when correctly handled. We assume you are referring to the simple super-regenerative type of receivers for use on 144 and 166 and a 166 Mc super-regenerative receiver was described in October, 1947. However, such equipment is not looked upon very favourably for these bands, due to the severe interference they cause. The superhet is almost universal now.

J.G. (Melbourne, Vic.) sends in a correction to a circuit submitted for the "Reader Built It" page.

A. Your circuit is still not right, in that you have the capacitors in series with the supply lines to the receiver instead of bypassing the lines to earth.

B.H.K. (Ingham, Qld.) asks about the Australian Shortwave Handbook.

A. The last edition of the book was published in 1950 and we have no immediate plans to produce another edition. Possibly there will be another edition at some time in the future but in the meantime you will find a proportion of shortwave material in the pages of Radio, Television and Hobbies.

L.J.A. (Perth, W.A.) includes items for "Here's Your Answer, Tom," and "Let's Buy An Argument" as well as a few suggestions regarding the running of the magazine in general.

A. All items noted. We find it hard enough to design, construct and test sufficient projects for new issues to be published monthly; a weekly issue would ensure that all members of our staff ended in an early grave. In order to list projects which are to appear in a following issue, it would be necessary for us to work about two months ahead of publication date, because not all projects which we begin actually appear in print. Some are discarded because they do not work as well as we had previously hoped and others because of parts supply and other reasons.

P.J.H. (Melbourne, Vic.) wishes to use a 1F5 valve as an extra stage on a small receiver and wants to know if a 10,000 ohm transformer would be correct for this valve.

A. The correct load for this valve is between 16,000 and 20,000 ohms according to the manner in which it is used. However, don't let that stop you, P.J.H., as the set will still work, and work quite well, with this order of mismatch. In fact we doubt whether you will notice the difference in practice, and it would certainly not justify spending money on a new transformer.

J.F.F. (Mangapehi, N.Z.) wants to know whether a version of the VCR97 can be used for the Small Oscilloscope circuit published in the October, 1957, issue. He also expresses his appreciation of our magazine and the interest and assistance it offers.

A. As a matter of interest some details on the VCR-97 tube appeared in the April, 1958, issue, and we would refer you to this in addition to any other data you may have. We doubt whether this tube would be suitable for use in the circuit as it stands, and would be more suitable for use in one of the simpler 5BP1 circuits we have published in the past. Copies of these could be obtained through our postal service. Many thanks for your kind remarks about the magazine.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

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n while you
d a receiver

nued from page 55.)

e the misfortune to strike
nponent) it should be possi-
the unit as a simple audio
r a start, plug in the 6BV7
t to the mains. and switch

be possible to see the fila-
6BV7 as it warms up after
nds, and this will indicate
rt of the circuit is correct.
off, plug in the 6X4, and
gain. Watch the 6X4 care-
y signs of distress, such as
ie flashes, etc., which
ate a short circuit in the
somewhere. If nothing like
he set may be left running.
a good idea if you can
se of a multimeter at this
may be possible to borrow
ssibly the owner along with
you check that all is well.
ypical voltages will be found
the article, and your set
approximately the same
lerance of at least plus or
is allowable.
well you can try feeding
into the volume control
ıld be heard in the
simplest source of signal—
not—is your finger. If you
r on the "active" terminal
ne control, with the latter
ed, you should produce a
ite audible hum in the
s is a rough, but fairly
lication that the stage is
ectly.
more useful signal is that
tal pickup, and you may
borrow one of these from
you do not already possess
normally be fitted with a
(i.e., single conductor in
id) the conductor being the
the shield the "earthy" side
t. Simply connect the con-
active volume control ter-
ne braid to the chassis. If
ou should produce a useful
at the speaker.
s about all for this month
eel sure, to keep you occu-
ext month, when we will
story around the detector,
amplifier stages.
o be Continued)

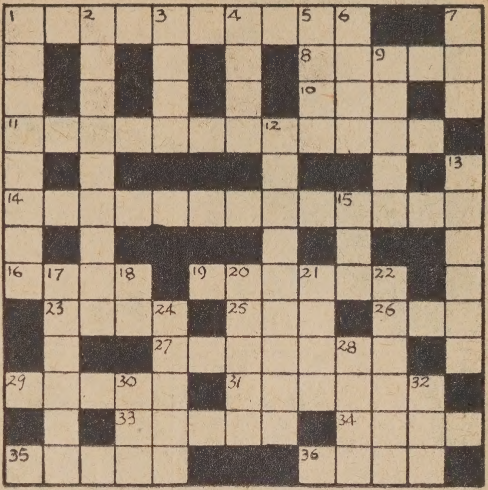
ABOUT AUDIO
AND HI-FI

nued from Page 47)

ıt and then make all their
15-ohm resistor across the
wonder they produce such
sults. I ask you, how many
look like a pure resistance?
has already expatiated in
he difficulty of matching
speakers to an amplifier
ıg watts into sound with-
losses. Many moving coil
a steep rise in impedance
nd above 2,000 cps. It is
mber that a rise from 15
ohms reduces 10 watts to
ertheless this is often for-
irtue of a level impedance
be over-emphasised.
ncluded.)

Solution and further crossword next month

THE R., T.V. & H. CROSSWORD No. 50



ACROSS

1. Due to electron emission (adj.).
8. Rises on wings.
10. Pounds, shillings, pence (abbrev.).
11. Electrical measuring instrument.
14. Needed by all radio servicemen (2 words).
16. An inert gas.
19. Duty list.
12. Emmet (pl)
25. To prosecute.
26. Largest Australian bird.
27. Water-course.
29. Major leg bone.
31. Young cat.
33. Supporting attachment.
34. Units.
35. Concur.
36. Before (prefix).

DOWN

1. Used for valve filaments.
2. Disruptive expansion of gas.
3. Supports electrodes in valves.
4. Man's name.
5. Island.
6. Price.
7. Inquire.
9. Girl's name.
12. To permit operation from power mains (2 words).
13. To increase.
15. Girl's name.
17. Freeing.
18. Northern Territory (abbrev.).
20. Japanese City.
21. Temporary dwelling.
22. To be sorry for.
24. Reference table.
28. English University.
30. Frozen water.
32. Born (Fr.).

FROM THE SERVICEMAN WHO TELLS

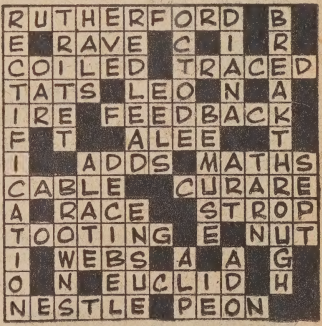
(Continued from page 61)

section, in this case biasing it almost to cut-off. As a result, it had virtually no gain, and the little signal which did force itself through was horribly distorted.

Thus the lower output valve was not only inadequately driven, it was fed with a badly distorted signal into the bargain. Small wonder that distortion showed up at such a low output.

So there we are; three classic cases of leaky coupling capacitors, each with its own little peculiarity. Enough variety to keep me satisfied for some time to come.

Last month's solution



R	U	T	H	E	R	F	O	R	D		B	
E		R	A	V	E		C		I		R	
C	O	I	L	E	D		T	R	A	C	E	D
T	A	T	S		L	E	O		N		A	
I	R	E		F	E	E	D	B	A	C	K	
F		T			A	L	E	E			T	
I			A	D	D	S		M	A	T	H	S
C	A	B	L	E			C	U	R	A	R	E
A		R	A	C	E			S	T	R	O	P
T	O	O	T	I	N	G		E		N	U	T
I		W	E	B	S		A		A		G	
O		N		E	U	C	L	I	D		H	
N	E	S	T	L	E		P	E	O	N		

HERE'S YOUR ANSWER, TOM

(Continued from page 63)

wards and forwards with no significant difference in most cases.

Your final question about the potentiometer could not be answered without knowing more about the circuit in which it is to be used. There are some cases where the difference would not be important but there are other cases where it would make a major difference to the operation of the circuit. In the case of most small receivers, the change would mean an increase in the distortion of a detector, a difference in the bass response of an amplifier or something similar and you need not normally be afraid of permanently damaging components by making the substitution.

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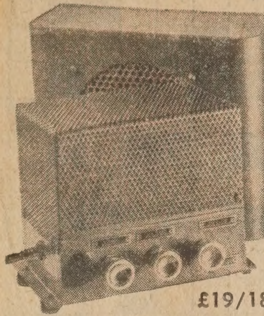

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.... **Age** ...... (R.H.658)

Answers to corresponde

B.C.J. (Brisbane, Q.) offers a number of suggestions for projects and features in the magazine.

A. The tuner you suggest would not be greatly different from many we have described in the past, and which would at least serve as a basis for design if you should care to experiment. However, we are not quite sure as to the exact purpose of the complete project, and feel that better results may be obtained by a different combination of units. If it is proposed to operate the entire equipment from an accumulator, it would be necessary to consider the total power requirements very carefully, since it is quite likely that they would exceed the capacity of the vibrator supply unit. If you care to let us have more details of the exact purpose of the equipment we could probably advise you further. We are keeping in mind the subject of model control, and you may care to refer, in the meantime, to the September, October and November, 1950, issues for an interesting series on this subject. Many thanks also for the suggestion regarding the past projects reference, but we are afraid this would be difficult to introduce.

K.H.W. (Geebung, Q.) asks if we intend producing an amplifier handbook and also a number of questions on audio.

A. The amplifier handbook has not been forgotten but we have been faced with so many new and complicated projects over the last couple of years, notably television, that it has been impossible to undertake any new handbooks. Cathode follower output stages for amplifiers do not offer all the advantages that would first appear. While the output impedance and distortion of the output stage are both very low, the output valves require a high driving voltage and the design of a low distortion voltage amplifier becomes a problem. The relative merits of single and multiple speaker systems have been discussed in the magazine but no simple conclusion can be drawn. Some like one system, some the other and it largely resolves into a matter of individual taste.

A.D.R. (Bentleigh, Vic.) is anxious to obtain further information concerning the line filter mentioned in a recent Answer Tom article.

A. A complete line filter was described in the January and July, 1953, issues, and copies of the circuit and other details may be obtained through our 2/ mail service in the usual way.

R.B. (Artarmon, N.S.W.) requests that we publish details of a 5in TV receiver.

A. Such a set was described in the September, 1957, issue, and a few copies of this are still available if you require a copy. This, coupled with articles in the December, 1956, and January,
1957, issues (also available) makes a
plete discussion of the whole subject.

I.B. (East Preston, Vic.) reports th
built the Three Band Three and has
excellent results from it. He also want
whether the ECL80 valve is readily ava
what are the pin connections for this

A. Many thanks for the report on
Band Three and we are glad to learn
have found it so successful. The EC
should normally be available and we
contact either Mullard or Philips if
any difficulty in obtaining it. The p
tions are as follows: 1, triode plate;
grid; 3, cathode; 4 and 5, heaters;
plate; 7, suppressor; 8, screen; 9, grid.

W.R.F. (Victor Harbour, S.A.) want
in what issue we described the 32 Vo
Receiver, and how to fit a pickup to th

A. This set was described in the Oct
issue and the circuit as it stands is pro
pickup terminals and the necessary swi

G.F.C. (Parkes, N.S.W.) writes to t
he has now located a trouble which was
bothering him regarding the 6in. TV Re
parently he is able to receive fairly reg
tion of Channel 2 in this location, whic
remarkable in itself. He also suggest
shape of the picture may be improved
a ring of insulated wire around the scr
VCR97 and connecting it to the EHT p

A. Many thanks for your report G.F.
have noted the cure for your incorrect
quency. Since this did not appear to b
on the original, we can only assume
trouble was the result of a combinatio
ponent values which, collectively, differe
original by a significant amount. Your
for an article is noted, but we have li
tunity to experiment under the cond
describe. A description of some of th
you encountered and how they may be
might be of interest to other readers if
to write about them.

J.S. (Arncliffe, N.S.W.) is anxious for
cribe a five valve communications receiv
the popular ham bands and having as
lities as possible.

A. Many thanks for your suggestion I
will keep this idea in mind. A set of t
type was described some years ago (C
tions Five, September, 1940) and it m
sible to produce a more modern versi
same thing. However, it must be realis
facilities which can be provided in such
distinctly limited, and they may be inad
many of the crowded band conditions
encountered at the present time.

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200 kc-31mc inc. B'cast band. Band
ham bands. Leatherette spkr. cabinet,
let. 1st class order, snap £45. Very
h.t. power pack, 1000v at 200 m.a.
class, £15. Commercial 80 m.c. mo
ceiver unit. As new, complete. Eas
to 50 or 144 m.c. **A. Shaw, c/o
Brisbane.**

SELL: Inverter, 240 DC; 240 AC,
filtered, as new, £16/10/. **J. Lo
Bay, Vic.**

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mitters, and one 10 c.c. twin oppos
motor. **G. Miles, 190 Croydon Rd.
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Vic.**

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